**From:** Clark, Karen
**To:** Darnell, Joseph
**Subject:** Re: Seismic data request
**Date:** Monday, November 13, 2017 1:35:24 PM

---

Hey Joe, just checking back in to see if you need anything from us on this... if so, please let me know!

Thanks, Karen

Karen P. Clark
Deputy Regional Director
U.S. Fish & Wildlife Service- Alaska Region
1011 E Tudor Rd, MS 374
Anchorage, AK 99503
karen_clark@fws.gov
907.786.3542 office
907.786.3493 direct
907.786.3306 fax

On Wed, Nov 8, 2017 at 4:20 PM, Darnell, Joseph <joe.darnell@sol.doi.gov> wrote:

> No, I haven't talked to them. Good idea.
>
> Joe
>
> *Joseph Darnell*
> *Regional Solicitor*
> *Alaska Region - Dept. of the Interior*
> *Anchorage, Alaska*
> *Direct Phone (907) 271-4118 / Main Office Phone (907) 271-4131*
> *Fax (907) 271-4143 / Mobile (907) 301-6687*
> *joe.darnell@sol.doi.gov*
>
> On Wed, Nov 8, 2017 at 3:23 PM, Karen Clark <karen_clark@fws.gov> wrote:
>
> > Thanks Joe. Have you checked with BLM? Maybe they have some info?
> >
> > Sent from my iPhone
> >
> > On Nov 8, 2017, at 11:59 AM, Darnell, Joseph <joe.darnell@sol.doi.gov> wrote:
> >
> > > Karen -
> > >
> > > I am addressing some legal issues over use of the data. I had a call from Stephanie who is looking. What I told her I would like to know is what if anything the permittee and the participating companies were told by the Service about how the data was to be handled. If FWS doesn't have any remaining file, then I guess it doesn't have it. b5 - AC [redacted]

b5 - AC [redacted]

Thanks for checking.

Joe

*Joseph Darnell*
*Regional Solicitor*
*Alaska Region - Dept. of the Interior*
*Anchorage, Alaska*
*Direct Phone (907) 271-4118 / Main Office Phone (907) 271-4131*
*Fax (907) 271-4143 / Mobile (907) 301-6687*
*joe.darnell@sol.doi.gov*

On Wed, Nov 8, 2017 at 11:27 AM, Karen Clark <karen_clark@fws.gov> wrote:

> Hey Joe- just checking back in on this one- do you have a suspense date for this request?
>
> Thanks, Karen
>
> Karen P. Clark
> Deputy Regional Director
> U.S. Fish & Wildlife Service- Alaska Region
> karen_clark@fws.gov
> 907.786.3542 office
> 907.786.3493 direct
> 907.786.3306 fax
>
> On Nov 7, 2017, at 8:37 AM, Karen Clark <karen_clark@fws.gov> wrote:
>
> > Hey Joe, I am helping to track down the information you requested- just wondering what your turn around for this is?
> >
> > Thanks, Karen
> >
> > Karen P. Clark
> > Deputy Regional Director
> > U.S. Fish & Wildlife Service- Alaska Region
> > karen_clark@fws.gov
> > 907.786.3542 office
> > 907.786.3493 direct
> > 907.786.3306 fax

**From:** Arthur, Stephen
**To:** Leonetti, Crystal
**Cc:** Damberg, Doug; Joanna Fox
**Subject:** Re: ANWR photo
**Date:** Tuesday, November 14, 2017 9:27:37 AM
**Attachments:** image001.png

---

Crystal,

I am working remotely so I do not have access to the Refuge photo library. I do have a couple of similar images on my computer (attached). The two ground-level photos (pch1 and pch2) are FWS file images; the aerial photo (pch and beaver) is one of my own.

Perhaps someone at the Refuge can find the specific images from the brochure.

Steve

Stephen M. Arthur, Ph.D.
*Supervisory Wildlife Biologist*
*Arctic National Wildlife Refuge*
*101 12th Ave., Room 236*
*Fairbanks, AK 99701*
*(907)455-1830*

On Mon, Nov 13, 2017 at 4:08 PM, Leonetti, Crystal <crystal_leonetti@fws.gov> wrote:

> Dan Joling says, of the attached document:
>
> > Crystal,
> >
> > We like the photo on page 3 of the caribou with the mountains in the background. The one that says “Wildlife” in the upper right-hand corner.
> >
> > We also like the one on page 7: the aerial view that shows thousands of caribou about he size of rice grains.
> >
> > Thanks much.
> >
> > I’m leaving now but will speak to you or Andrea on Tuesday.
> >
> > Dan
>
> *Crystal Leonetti*
> Alaska Native Affairs Specialist
> Alaska Region - R7 External Affairs tEAm
> U.S. Fish & Wildlife Service
> 1011 E. Tudor Road
> Anchorage, AK 99503
>
> Direct: 907-786-3868
> Mobile: 907-230-8419
>
> “Consultation is a process that aims to create effective collaboration with Indian tribes and to inform Federal decision-makers. Consultation is built upon government-to-government exchange of information and promotes enhanced communication that emphasizes trust, respect, and shared responsibility. Communication will be open and transparent without compromising the rights of Indian tribes or the government-to-government consultation process.” –S.O. 3317

(Department of the Interior Policy on Consultation with Indian Tribes)

On Mon, Nov 13, 2017 at 3:46 PM, Leonetti, Crystal <crystal_leonetti@fws.gov> wrote:

Hi Doug and Steve,
Do you have any photos handy that would work for a very reliable Alaskan Associated Press journalist?
Thanks!

*Crystal Leonetti*
Alaska Native Affairs Specialist
Alaska Region - R7 External Affairs tEAm
U.S. Fish & Wildlife Service
1011 E. Tudor Road
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---------- Forwarded message ----------
From: **Joling, Dan** <djoling@ap.org>
Date: Mon, Nov 13, 2017 at 3:02 PM
Subject: ANWR photo
To: "Crystal_Leonetti@fws.gov" <Crystal_Leonetti@fws.gov>

Hi Crystal,

Just got an automatic email from Andrea saying she'd out of the office.

We're looking for an agency photo of caribou on the coastal plain of ANWR.

I looked in the USFWS digital archives and the selection is pretty limited, which makes me think I'm not very skilled at using your archives.

The Washington Post had a photo of caribou on the plain with the Brooks Range in the background. I didn't see it in the digital archives. Am I looking in the wrong place? Can you help?

Thanks,

Dan

**Dan Joling**

**Newsman**

**The Associated Press, Anchorage**

**(907)-272-7549, office**

**(907)-223-2111, cell**


AP

**From:** Arthur, Stephen
**To:** Leonetti, Crystal
**Cc:** Damberg, Doug; Joanna Fox
**Subject:** Re: ANWR photo
**Date:** Tuesday, November 14, 2017 9:47:06 AM
**Attachments:** image001.png

---

Crystal,

I did find a copy of the photo they requested, but it is not of very high quality. I don't know if this will be sufficient. This one is also a FWS file photo.

Steve

Stephen M. Arthur, Ph.D.
*Supervisory Wildlife Biologist*
*Arctic National Wildlife Refuge*
*101 12th Ave., Room 236*
*Fairbanks, AK 99701*
*(907)455-1830*

On Tue, Nov 14, 2017 at 7:26 AM, Arthur, Stephen <stephen_arthur@fws.gov> wrote:

> Crystal,
>
> I am working remotely so I do not have access to the Refuge photo library. I do have a couple of similar images on my computer (attached). The two ground-level photos (pch1 and pch2) are FWS file images; the aerial photo (pch and beaver) is one of my own.
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> > >
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> > >
> > > Dan

*Crystal Leonetti*
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Alaska Region - R7 External Affairs tEAm
U.S. Fish & Wildlife Service
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Direct: 907-786-3868
Mobile: 907-230-8419

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> Date: Mon, Nov 13, 2017 at 3:02 PM
> Subject: ANWR photo
> To: "Crystal_Leonetti@fws.gov" <Crystal_Leonetti@fws.gov>
>
> Hi Crystal,
>
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The Washington Post had a photo of caribou on the plain with the Brooks Range in the background. I didn't see it in the digital archives. Am I looking in the wrong place? Can you help?

Thanks,

Dan

**Dan Joling**

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**The Associated Press, Anchorage**

**(907)-272-7549, office**

**(907)-223-2111, cell**


AP

**From:** Crystal Leonetti
**To:** Arthur, Stephen
**Cc:** Damberg, Doug; Joanna Fox
**Subject:** Re: ANWR photo
**Date:** Tuesday, November 14, 2017 9:49:05 AM
**Attachments:** image001.png

---

These are beautiful Steve, thank you for these! Do you know which mountains are in the background? Joanna, if you do have the ones from the brochure, I'd like to pass those along as well. I'm sure Dan will love these.

Sent from my iPhone

On Nov 14, 2017, at 7:27 AM, Arthur, Stephen <stephen_arthur@fws.gov> wrote:

> Crystal,
>
> I am working remotely so I do not have access to the Refuge photo library. I do have a couple of similar images on my computer (attached). The two ground-level photos (pch1 and pch2) are FWS file images; the aerial photo (pch and beaver) is one of my own.
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> Perhaps someone at the Refuge can find the specific images from the brochure.
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>
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> > >
> > > Thanks much.
> > >
> > > I’m leaving now but will speak to you or Andrea on Tuesday.
> > >
> > > Dan
> >
> > *Crystal Leonetti*
> > Alaska Native Affairs Specialist

Alaska Region - R7 External Affairs tEAm
U.S. Fish & Wildlife Service
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Anchorage, AK 99503

Direct: 907-786-3868
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Thanks,

Dan

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<pch and beaver.jpg>

<pch1.jpg>

<pch2.jpg>


AP

**From:** Crystal Leonetti
**To:** Arthur, Stephen
**Subject:** Re: ANWR photo
**Date:** Tuesday, November 14, 2017 9:50:00 AM

---

Thank you Steve!

Sent from my iPhone

On Nov 14, 2017, at 7:46 AM, Arthur, Stephen <stephen_arthur@fws.gov> wrote:

> Crystal,
>
> I did find a copy of the photo they requested, but it is not of very high quality. I don't know if this will be sufficient. This one is also a FWS file photo.
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Thanks,

Dan

<image001.png>

**Dan Joling**

**Newsman**

**The Associated Press, Anchorage**

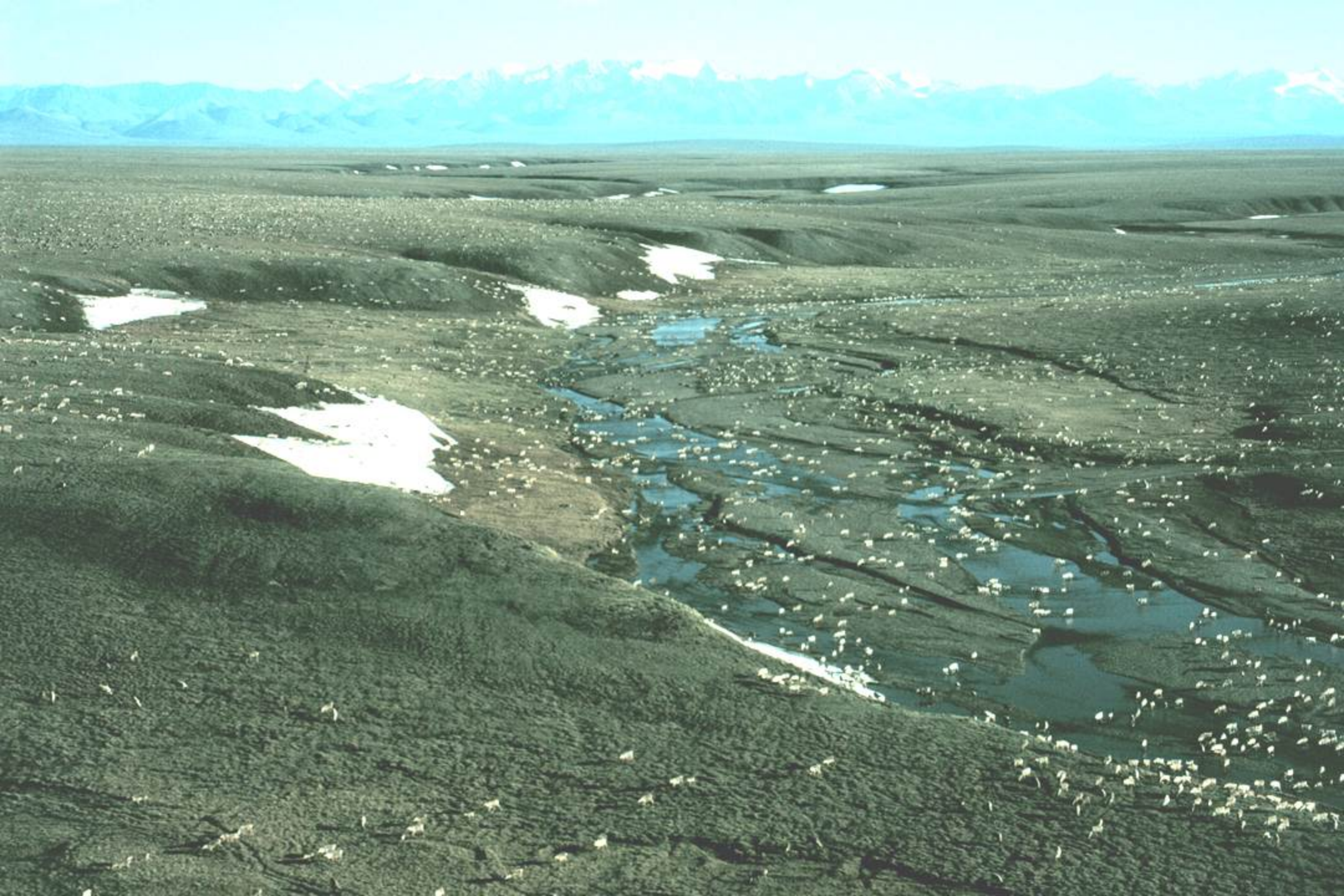
**(907)-272-7549, office**

**(907)-223-2111, cell**

[IP_US_DISC]



<pch3.jpg>



| | |
|---|---|
| **From:** | Gustavson, Angela |
| **To:** | Miel Corbett; Chris Tincher; Garrett Peterson; Kristen Peters; Christine Eustis; Roya Mogadam; Howard, Amee; Snow, Meghan; Martin Kodis; Lisa Jones; Devin Helfrich; Taylor Pool; Hausman, Alyssa; Marian Howe; Lesli Gray |
| **Subject:** | Reminder: National CLA Call today at 2:00 pm ET |
| **Date:** | Tuesday, November 14, 2017 9:58:25 AM |
| **Attachments:** | Natl CLA Call 10.31.17.docx |

Hi all,

We'll hold our National CLA call today, Tuesday, November 14 at 2:00 pm ET. Notes from our last call are attached.

The call in information is below.

Phone number: b5-CIP
Participant passcode: b5-CIP

Thanks,

Angela

Angela Gustavson
Deputy Chief
Division of Congressional and Legislative Affairs
U.S. Fish and Wildlife Service
Office: 703-358-2253
Mobile: 202-909-5105
angela_gustavson@fws.gov

**National Congressional and Legislative Affairs Call**
**October 30, 2017**

## Items of general interest from HQ

- Preparing for Senate ENR hearing on energy development in 1002 area in Arctic NWR, Greg Sheehan is testifying, mock hearings today and tomorrow
- Senate Interior Appropriations hearing on FY18 budget has been postponed for a couple weeks, no rescheduled date yet
- Last Friday, Lisa and Region 2 SAC met with Indian Affairs Committee staffers, and provided an overview on how we enforce the Indian Arts and Crafts Act
- FISH Act hearing QFRs, now with OCL
- Last week, House passed 2 ESA bills to overhaul sue and settle process, update public comment requirements, and prevent payments to 3rd parties, but it's not likely to go anywhere in the Senate
- This week, House is voting on Forest Management bill, which considers litigation for forest management projects and permit waivers for ESA activities. It's likely to pass easily in the House.
- Report to Congress for WRDA just sent out
- FWS and other agencies signed MOU to further campaign to increase hunting and fishing recruitment
- Recovery for America's Wildlife Act likely to be introduced this week, which deals with offshore and onshore revenues for state wildlife action plans

## Items of general interest from Regions

Region 2:

- Lesli inviting district staffers to a mussel briefing, which will provide an overview of our research to identify mussel locations and needs for conservation

Region 3:

- Hosted staffers from House Interior Appropriations minority staffers at Minnesota Valley NWR, Rep. Betty McCullum (D-MN-4) attended and complimented the Service on our work in the area

Region 4:

- Developing hurricane overview materials that can be shared with appropriators and authorizers

Region 5:

- Bat week Hill events – 250 folks signed in for congressional reception, congressional briefing had standing room only. Thanks to Taylor for his support.
- In honor of five-year anniversary of Hurricane Sandy, working on coastal adaptation outreach for hurricanes to the Sandy-affected delegation and how hurricane funding is being implemented

Region 8:

- Met with Rep. Amodei (R-NV-2) and state agency to discuss BLM land management plans, focusing on fires and destruction of sage grouse habitat

**From:** Google Alerts
**To:** sara_boario@fws.gov
**Subject:** Google Alert - Arctic National Wildlife Refuge
**Date:** Tuesday, November 14, 2017 10:06:24 AM

Google Alerts

# Arctic National Wildlife Refuge

Daily update · November 14, 2017

NEWS

## Rescue our **Arctic National Wildlife Refuge**

Fairbanks Daily News-Miner

Do we honor ourselves and our place in the community of life if we make drilling for more oil in the **Arctic National Wildlife Refuge** all about money, ...

The Energy Case Against Drilling in the **Arctic National Wildlife Refuge** - Center For American Progress

Kit DesLauriers talks the future of **Artic National Wildlife Refuge** after October's drilling-friendly ... - Backcountry

Drilling opponents gird for battle - E&E News

Full Coverage

Flag as irrelevant

## Sen. Cory Gardner faces key test with **Arctic Refuge** drilling vote

The Denver Post

I'm referring to the **Arctic National Wildlife Refuge**, perhaps the most beautiful and unspoiled area left on Earth. For the past sixty years, the Arctic ...

Senators Spar Over Opening **ANWR** For Drilling - Global Trade Magazine (blog)

Senator disregarded native testimony on **ANWR** drilling - The Daily Herald

Harrop: Selling our **wildlife** birthright for a paltry return - The Daily Herald

Full Coverage

Flag as irrelevant

## Senate Panel to Mark Up **ANWR** Proposal This Week

Natural Gas Intelligence

A Senate panel plans to meet this week to mark up a proposal to open a portion of the **Arctic National Wildlife Refuge** (**ANWR**) to oil and gas ...

Flag as irrelevant

## American Petroleum Institute expresses support for legislation to expand access to **Arctic National** ...

Daily Energy Insider

“Safe and environmentally responsible energy development in the **ANWR** coastal plain holds great promise for our nation's energy security and ...

Flag as irrelevant

## Maine Compass: Who really pays for tax cuts?

Kennebec Journal & Morning Sentinel

She showed her moxie and became a national celebrity, recognizing the ... oil drilling in the **Arctic National Wildlife Refuge**, home to the Gwich'ins.

Flag as irrelevant

## Who wants to kill the electric car again?

Salon

... and the resulting need to pump up government revenues, as an excuse to open up oil drilling in the **Arctic National Wildlife Refuge**, even though all ...

Flag as irrelevant

## These Unruly GOP Tax Factions Will Put Senate's Plan in Question

Bloomberg

... gave her an enticement in the budget vehicle for the tax debate: a fast-track vote to permit oil drilling in Alaska's **Arctic National Wildlife Refuge**.

Flag as irrelevant

## Diane Brower: We must be stewards of the environment

Steamboat Pilot & Today

"The coastal plain of **Arctic National Wildlife Refuge** on Alaska's North Slope is one of the most intact and untouched ecosystems in America.

Flag as irrelevant

## Senate tax bill would keep credits for wind, solar and EVs

Midwest Energy News

A bill calling for at least two major lease sales in Alaska's **Arctic National Wildlife Refuge** would generate $2 billion in oil and gas royalties over the ...

Flag as irrelevant

## News From the Oil Patch, Nov. 14

hays Post

Alaska Republican Senator Lisa Murkowski introduced a bill that would open up the coastal plain of the **Arctic National Wildlife Refuge** to oil and gas ...

Flag as irrelevant

WEB

## In Their Words: Scientists On Why the **Arctic Refuge** Must Remain Wild

National Audubon Society

The **Arctic National Wildlife Refuge** is remote and roadless, and few people have the opportunity to visit. Even so, for decades Americans have stood ...

Flag as irrelevant

## WCS Urges Senate Committee to Reject **Arctic Refuge** Drilling Legislation

WCS Newsroom - Wildlife Conservation Society

“The **Arctic National Wildlife Refuge** is home to a wide variety of wildlife and roughly 700 kinds of plants, 200 bird species, 47 mammal and 42 fish ...

Flag as irrelevant

## **ANWR** Drilling Opponents Outline Battle Plan

Society of Environmental Journalists

"Senate opponents of drilling in the **Arctic National Wildlife Refuge** hope to convince their colleagues over the next few weeks that energy ...

Flag as irrelevant

**From:** Fox, Joanna
**To:** Crystal Leonetti
**Cc:** Arthur, Stephen; Damberg, Doug
**Subject:** Re: ANWR photo
**Date:** Tuesday, November 14, 2017 10:17:06 AM
**Attachments:** image001.png

---

Which brochure are you referencing? I did not receive any attachments.

Cathy Curby is most familiar with our brochures and photo library. She is currently volunteering for us on Wednesdays (working remotely from the east coast). I am copying her in the event she can assist with this request first thing tomorrow morning. In the meantime I'll see if I'm able to find anything.

Thank you,
Joanna


Joanna L. Fox
Deputy Refuge Manager
Arctic National Wildlife Refuge
101 12th Avenue, Room 236
Fairbanks, AK 99701
(907) 456-0549


Follow us on Facebook!
www.facebook.com/arcticnationalwildliferefuge

*"Do what you can, with what you have, where you are." -- Theodore Roosevelt*

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*Crystal Leonetti*
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**(907)-272-7549, office**

**(907)-223-2111, cell**



<pch and beaver.jpg>

<pch1.jpg>

<pch2.jpg>


AP

**From:** Arthur, Stephen
**To:** Crystal Leonetti
**Subject:** Re: ANWR photo
**Date:** Tuesday, November 14, 2017 10:17:43 AM
**Attachments:** image001.png

---

Yes, the aerial photo of the Beaver is on the coastal plain. The mountains in the background of the other photos are the Romanzof Mtns, or more generally, the Brooks Range.

Steve

Stephen M. Arthur, Ph.D.
*Supervisory Wildlife Biologist*
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**Subject:** Re: ANWR photo
**Date:** Tuesday, November 14, 2017 10:20:50 AM
**Attachments:** image001.png

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It is the "A Sense of the Refuge" brochure.

Steve

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**Cc:** Arthur, Stephen
**Subject:** Re: ANWR photo
**Date:** Tuesday, November 14, 2017 10:20:58 AM
**Attachments:** image001.png
Sense of the Refuge booklet web.pdf

---

Hi Joanna,
Sorry about that. I provided Dan Joling with the attached booklet and he was interested in the two caribou herd photos. Steve emailed me the one that they look like rice grains, so now I'm only looking for the other one on page 3.

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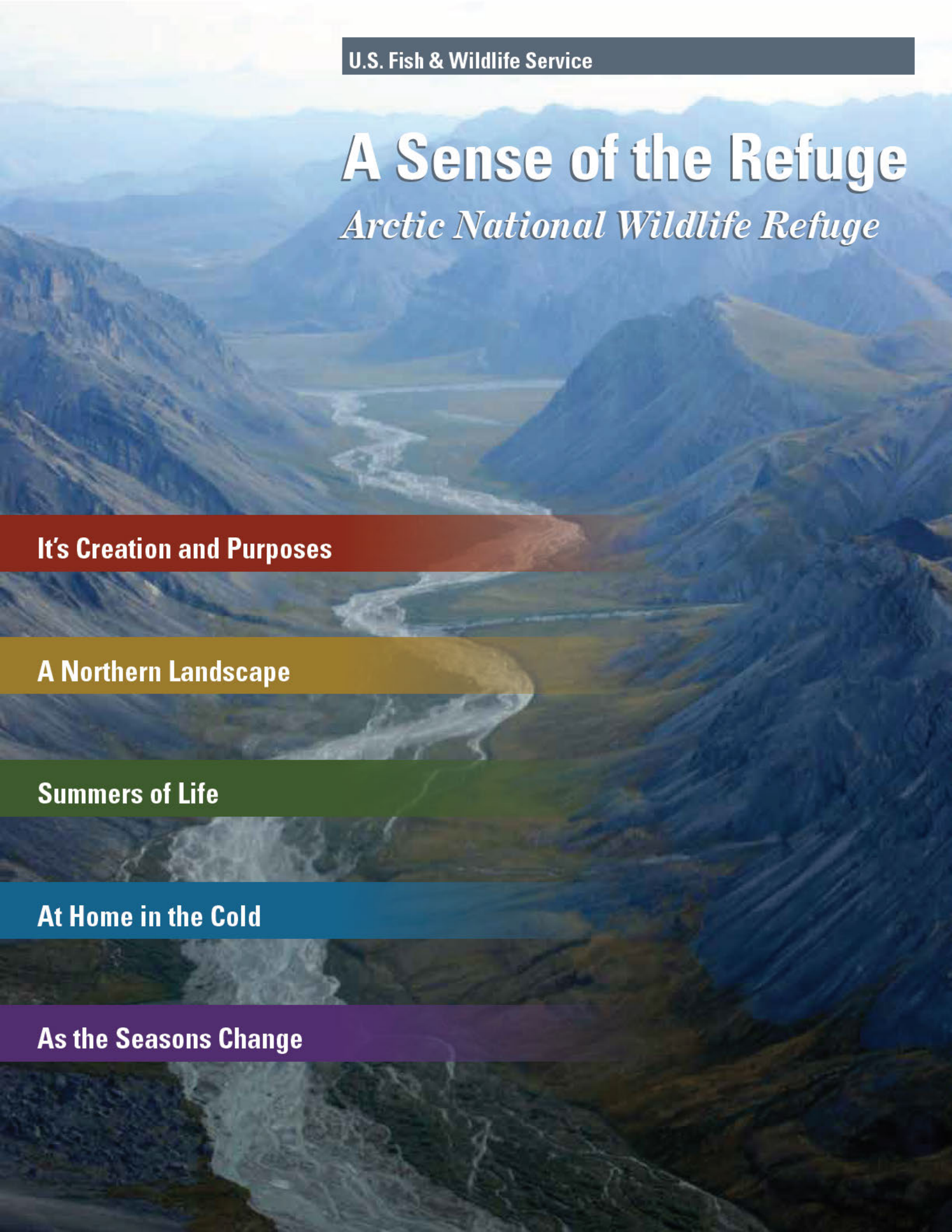


U.S. Fish & Wildlife Service

# A Sense of the Refuge

## *Arctic National Wildlife Refuge*

It's Creation and Purposes

A Northern Landscape

Summers of Life

At Home in the Cold

As the Seasons Change


## A National Response

Throughout the first half of the 20th century, Americans became increasingly concerned about ecological problems including wide-spread deforestation, loss of wildlife, and air and water pollution.

This awakened a growing appreciation for wilderness, and a recognition that areas of wildness needed to be preserved or they would disappear.

One response to these concerns was the creation of a new conservation area in northeast Alaska: The Arctic National Wildlife Range was established in 1960.

In 1980, the Alaska National Interest Lands Conservation Act redesignated the Range as part of the Arctic National Wildlife Refuge and enlarged the area.

As the founders intended, Arctic Refuge preserves a wild region for us today and for our grandchildren tomorrow.

*Courtesy of the Jay N. "Ding" Darling Society*

**Rivers were once thought to be a natural dumping grounds. The fish in the cartoon says, "And they complain because self respecting fish won't live in their streams." J.N. "Ding" Darling drew this cartoon in 1923.**

## Refuge Purposes

Arctic Range was established to preserve "unique wildlife, wilderness and recreational values."




The Alaska National Interest Lands Conservation Act provided new purposes for the entire Refuge: to conserve animals and plants in their natural diversity, ensure a place for hunting and gathering activities, protect water quality and quantity, and fulfill international wildlife treaty obligations.

## National Interest

A survey of national print media indicates the Arctic Refuge is most valued by the American people for its wildness and naturalness—a place of undisturbed wildlife and wild landscapes.


## A Vast Wild Place

Arctic Refuge is about 19.3 million acres. It's approximately the size of South Carolina and has no roads, marked trails, or campgrounds.

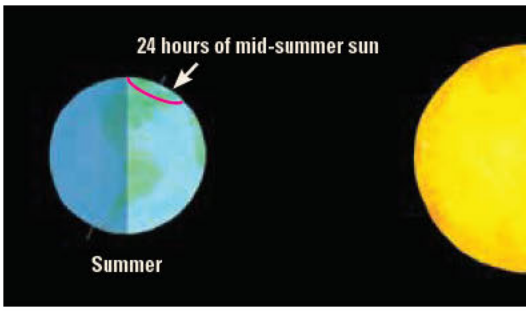

## ANWR is a Wildlife Refuge

ANWR (pronounced "an-whar") gets mentioned in the news a lot. ANWR is really the Arctic National Wildlife Refuge.

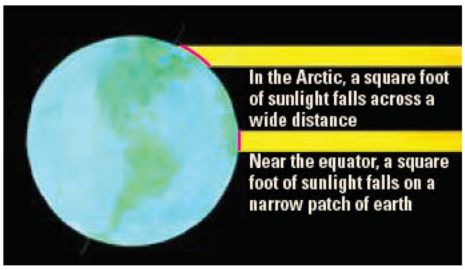
When we hear "ANWR," it's easy to forget it is National (it belongs to all Americans), it's for Wildlife, and it's a Refuge (a conservation area managed by the U. S. Fish and Wildlife Service).

# A Northern Landscape


## Sunshine is Key




In the Arctic, the mid-summer sun never sets, but the mid-winter sun never rises—sending a dusky twilight over the landscape.



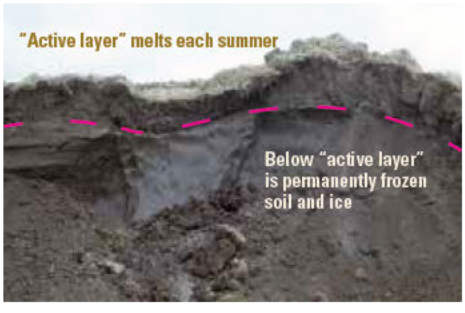

Living creatures derive their energy from the sun by eating plants that absorb the sun's rays, or by eating animals that feed on those plants.

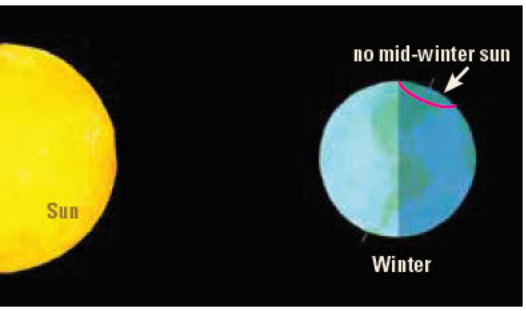
Because the low angle of sunlight in the Arctic causes the sun's energy to be spread thinly across the land, and because there are so many months of winter darkness, Arctic plants and animals have adapted to the low level of available energy.

## Frozen Soil

The arctic tundra is so cold that the ground beneath the surface stays frozen all year. This permanently frozen ground is called permafrost.

When the sun warms the surface, the top few inches of soil thaw, allowing plants to grow and insects to burrow. This thawed layer of soil is called the active layer.





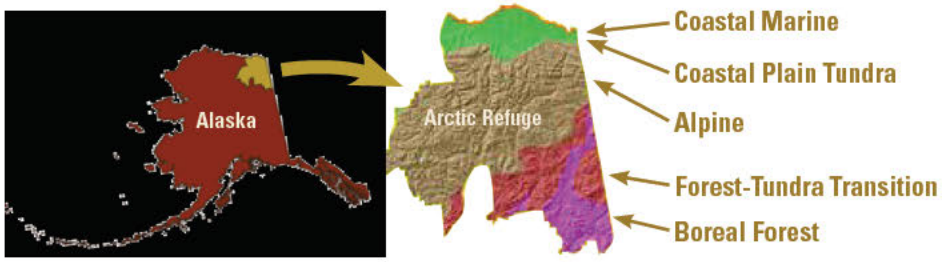

## Long-term Residents

Native peoples have lived in the northern and southern portions of what is now the Arctic Refuge for thousands of years. Their hunting and gathering activities provided the foods necessary to nourish their bodies and their cultures. They continue many of their traditional life ways to this day.

Inupiat Eskimos live along the northern coast. They hunt seals and whales, fish from barrier islands and along freshwater rivers, catch birds throughout the spring and summer, and travel inland to hunt caribou, wolves, and Dall sheep.

Gwich'in Athabaskan Indians live to the south. Traditionally, they traveled widely each year in search of food. They still establish summer fishing camps along rivers, catch waterfowl and other birds, snare small game, and hunt caribou. Historically, they built long wooden fences to direct migrating caribou to prime hunting areas.


## Five Ecological Regions




The **coastal marine** region, next to the Arctic Ocean, consists of salt marshes, lagoons, barrier islands, beaches and river deltas. These areas are important to polar bears, fish and migratory birds.

**Coastal plain tundra** is a treeless, flat to hilly region where caribou and birds raise young in summer. Polar bears den here in winter, and fish overwinter in deep pools along shallow rivers.

The **alpine** zone is the vast Brooks Range mountains, which are the northern-most extreme of the Rocky Mountains. Dall sheep, grizzly bears, wolves and ground squirrels live here.

The **forest-tundra transition** has spruce trees interspersed with low tundra plants. Caribou feed here through the winter. Moose and wolves roam here year-round.

The **boreal forest** is a mix of spruce, birch, and aspen trees. It is the only extensively forested area in the Refuge. This region is home to moose, lynx, weasels, and numerous song-birds.


## Distance from the Refuge

# Summers of Life

*Feel the wind as it rushes across the tundra and whips your hair.*
*Be thankful for it.*
*It has blown away the whine and sting of a million mosquitoes.*
*Lean into it.*
*It will hold you.*

Kelsey Bearden, Refuge visitor

## Land of the Midnight Sun

Summer in the Arctic is short but the days are long. On the coastal plain, the sun circles the horizon 24 hours per day. It will not set from mid-May until late July.

A multiple-exposure photo shows the sun reaching its lowest point over the horizon around midnight on a summer's eve.

For those two intense months, midday and midnight sun blend into one, and plants, animals, and people work hard to gather enough resources to survive the long winter season ahead.

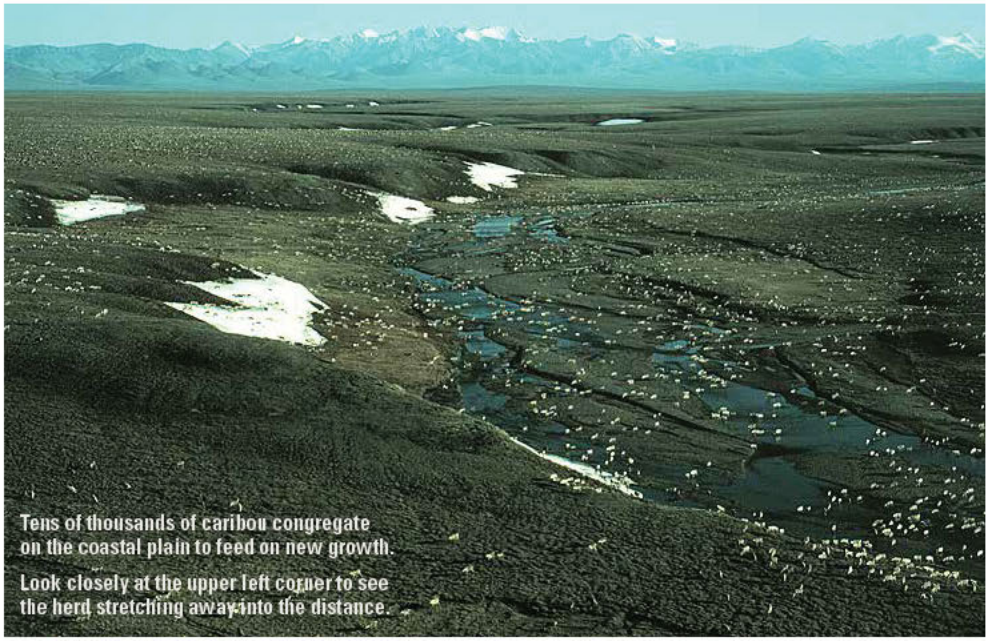
Plants and animals have adapted to these harsh conditions in a variety of surprising ways.

A lone grizzly bear searches for food in a sparse landscape.

## A Swivelling Solar Oven

Arctic poppy flower-heads turn toward the sun throughout each day as it moves across the sky. This allows the plants to make use of the summer's 24-hour daylight. The satellite-dish shape of each flower concentrates the heat of the sun, raising the temperature of its developing seeds by as much as 10°F. This gives the poppy an important boost in the short growing season.

Arctic Poppy blossoms face the sun.



Tens of thousands of caribou congregate on the coastal plain to feed on new growth.

Look closely at the upper left corner to see the herd stretching away into the distance.

## A Good Meal Draws Thousands from Afar

Plants are the foundation of the food chain in Arctic Refuge. They are eaten by grazers such as caribou. These grazers are in turn eaten by a smaller number of predators such as wolves and bears.

Throughout the year, a lot less sun falls on the Refuge than on areas farther south. This small amount of sunlight supports only a limited amount of plant growth.

As a consequence, plant-eaters such as caribou roam across hundreds of miles searching for the food they need for growth and reproduction.

If all the caribou in the Refuge were spread out at equal distance from each other, there would only be 3 to 4 caribou in each square mile of the Refuge. But plants grow unevenly. In early summer, abundant tender new growth on the coastal tundra attracts hungry caribou together into large aggregations of animals.

## The Smell of Smoke

In this northern environment, small changes in the climate can have a significant impact.

For example, increasingly dry conditions can lead to more frequent and larger wildfires in the Refuge. Warming temperatures are also having an effect.

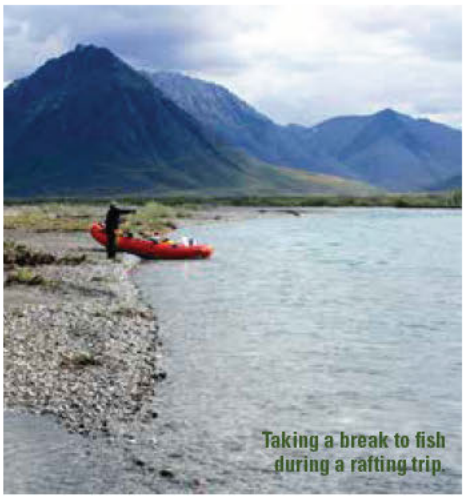
Wildland fire in the boreal forest.


Alpine glaciers in the Refuge shrank dramatically over the past half-century and are now melting ever more quickly. If current trends continue, all the glaciers in Arctic Refuge will be gone within 100 years.

## Visitors Seek Untamed Wilderness

When Arctic Refuge was established in 1960 it was already receiving occasional visits by hunters and hikers.

Visitation increased gradually throughout the 1970s, and more rapidly during the 1980s. A public use study in 1975 estimated 281 people visited the Refuge. By 1986 that figure doubled. Similarly, the number of commercial recreational guides increased from 7 in 1980 to 21 only nine years later.



Taking a break to fish during a rafting trip.

Since 1986, visitor numbers have increased another two and a half times. People generally stay 7-11 days, most often to backpack, float rivers, or hunt.

In a 2009 study, visitors said they most appreciated the Refuge's wilderness, vastness, remote isolation, opportunity for adventure, and natural conditions.

**Mosquitoes are drawn to the prospect of a meal. Like other creatures in Arctic Refuge, there are relatively few mosquitoes over the whole area, but they concentrate around favorable food sources.**

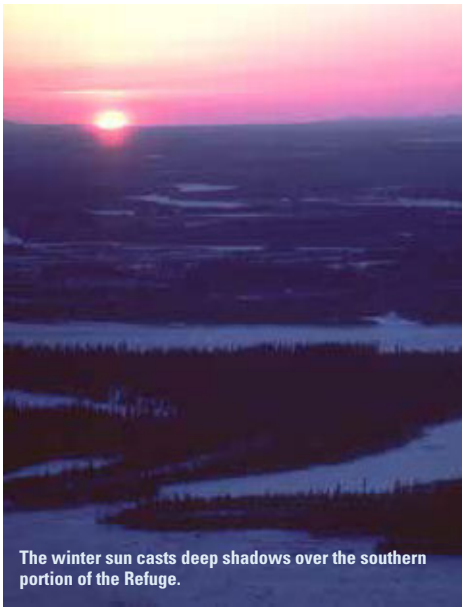
# At Home in the Cold

*"The moon is at its half phase, casting light and shadow on the snow-covered Romanzof mountains. The Hulahula ice field catches the red of the aurora. Amazing shapes form and disappear in the sky."*

Subhankar Banerjee, photographer and environmental educator

## Darkness and Light

In stark contrast to the brief, bright summer, winter in the Arctic is long, dark, and cold. Along the northern edge of the Refuge, the sun does not show its face from late November until mid-January. In the depths of darkness, during the months around the winter solstice, dusky sunlight seeps over the horizon for only a few hours each day.



The winter sun casts deep shadows over the southern portion of the Refuge.

Despite the lack of sunlight, it is not actually dark all the time. Dawn, blending into dusk, may last for hours; the winter moon, which, like the summer sun, circles overhead without setting, reflects off the expane of snow and illuminates the long nights; and the aurora borealis—the northern lights—occasionally glow in the starry sky.

Northern lights dance across the night sky.

## Survival Strategies

Arctic animals deal with winter in one of three ways. They can leave—migrate to a warmer climate; they can stay and sleep; or they can stay and keep active.

**Asleep...** A polar bear mother spends five months in her winter den. From late October she must rely on her body fat, layered on during warmer months, to feed herself and nourish her young. She usually gives birth to a pair of cubs in December. The cubs each grow to 15 pounds by the time all three emerge from their den in early April.


Looking out of a polar bear den

Mosquitoes survive the winter by replacing the water in their bodies with substances that act like antifreeze in a car. These chemicals keep their cells from being ruptured by ice crystals as the mosquitoes freeze.

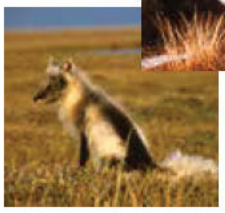

Young muskoxen frolic in the snow.

**Awake...** Muskoxen save energy during the winter by moving very little. They are also protected by foot-thick coats, covered by long guard hairs that shed snow and ice.

Like plants, lemmings use the blanket of snow as insulation. Hidden beneath, they create an intricate network of burrows where they stay active all winter, eating willow and dwarf birch twigs. At the beginning of winter, the collared lemming grows enlarged claws for shoveling tunnels through the snow. It is also the only rodent that turns white in winter. This helps lemmings hide from the hungry arctic foxes that depend on them to survive winter above the snow.


Collared lemming

Arctic fox - winter pelt



Arctic fox - summer pelt

The arctic fox's short legs and small ears help it retain body heat. Its thick coat not only keeps it warm, but, like the collared lemming it likes to eat, it turns white in winter. This camouflage helps the fox sneak up on prey and avoid becoming prey itself to polar bears and other large predators.

**Migrate...** Of the 200 bird species that have been recorded on the Refuge, all but about 25 of them migrate to warmer regions for the winter.

## Historic Temperatures

North of the Brooks Range the climate is classified as Arctic. Until recently, temperatures during February (the coldest month) averaged -4°F but extreme lows frequently dropped below -40°F.

South of the Brooks Range the climate is classified as Subarctic. Winter temperatures averaged -15°F to -20°F, with lows periodically reaching -50°F to -60°F.

## Feel the Chill


Cow moose nibbling her frosty lunch.
Photo from itsagreengreenworld.com

**When you take a breath of the sparkling -25°F air on a February day (the average low for much of the Refuge), your nose tingles and the air feels sharp in your lungs. As you breathe out a cloud of vapor, you may find your eyes gently frozen shut from the frost on your eyelashes. Welcome to winter.**

## Warming Winters

Climate change is bringing episodes of unseasonably warm weather to the Arctic winter—warming as much as 5-7°F in the past 50 years in Alaska and western Canada. One effect of these increases are icing events, when winter temperatures warm enough for freezing rain or thaws to coat the snow with a hard crust of ice. This can keep animals such as muskoxen from reaching the plants they need beneath the snow. Since the late 1990s, the number of muskoxen on the Refuge has declined, and icing events have likely contributed to this.

## Hidden from View

In winter, parts of the Refuge look barren—some say a great white expanse of nothing—but plants, and many animals and birds, as well as fish and insects, live here through the long winter. One question is, where is everything?

Most plants in the Arctic use snow as a protective blanket against extreme low temperatures and scouring winds. This partly explains why plants in the Arctic are so small. If they were taller, the winter wind and icy flakes would destroy any part above the snow.

Snow looks cold, but it is an effective insulator. The base of a snow pack may be +20°F while the air at its surface is -30°F. That's a 50 degree difference!


Willow branches scoured by blowing snow.

# As the Seasons Change

*"Caribou!
They flowed down
the shadowed valley
toward me..."*

George B. Schaller, internationally-recognized field biologist

## Times of Flux

Spring and fall are intense times of activity and transition. Animals and birds migrate to and from this remote northeastern corner of Alaska in great numbers. Plants burst out with new green growth and later shut down for the long, dark winter.

## Jumpstart on Growth

The sun shines brightly during the lengthening days of April and May, but snow still grips the land. Aspen trees jumpstart their growth by making use of this early-season light. Unlike most other trees, aspen bark contains chlorophyll, which begins photosynthesizing before the ground thaws and before leaves form.

But this special bark can easily sunburn in the intense light, so the trees produce a white surface powder to reflect some of the sunlight away from the delicate cells beneath. This effort requires energy, however, so aspen trees only do it where necessary—on their south sides facing the sun.

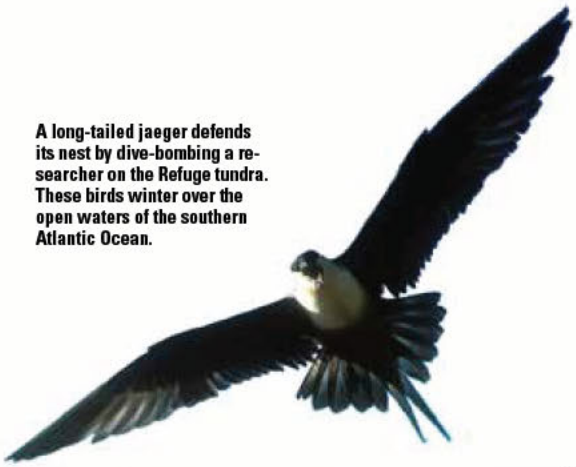
Every aspen trunk is therefore a natural compass—lighter on the south side and darker on the north.

**Look closely at this aspen trunk to see the lighter-color, powdery surface on the left, and the darker gray bark on the right. In this forest, SOUTH is to the left-hand side of the photo.**

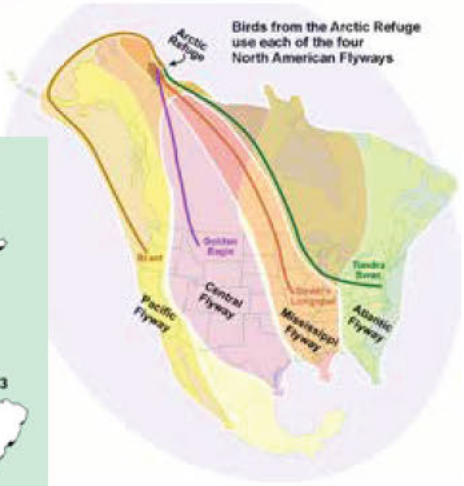
## Flying Great Distances

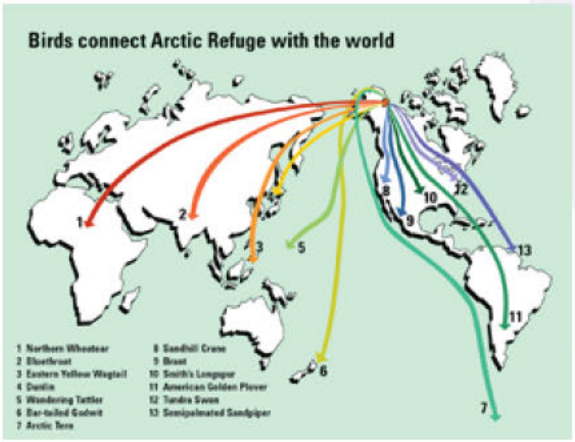
Birds migrate from all corners of the Earth to spend the summer in the Refuge, where long days produce an abundance of insects and plants for them and their young to eat.

The Refuge holds a unique position because it sits at the intersection of the four North American flyways, or main migration routes. Birds breeding on the Refuge have ranges that reach all 50 states as well as five other continents.



A long-tailed jaeger defends its nest by dive-bombing a researcher on the Refuge tundra. These birds winter over the open waters of the southern Atlantic Ocean.




The Northern Wheatear flies approximately 13,000 miles one-way from its breeding grounds on the Refuge, across Asia and the Middle East, to its wintering areas in Africa. This 6-inch bird then travels a similar distance back to Alaska each spring.

The Arctic Terns that breed on the Refuge migrate about 25,000 miles round-trip, flying south to Antarctica to escape winter in the northern hemisphere.

## Caribou Journey

Each spring, caribou of the Porcupine Herd move by the thousands on a focused march from their wintering grounds north to their calving range. The cows will soon have an urgent matter to attend to—the birth of their calves.

As temperatures cool, caribou amble back across the mountains, feeding slowly along the way to their wintering areas.

## hifting Seasons

; temperatures warm around the obe, many mammals, insects, birds d plants are facing challenges.

Arctic Refuge, where temperatures ten hover around freezing, a small mperature increase may cause amatic changes.

utrition is critical to pregnant ribou, particularly after the long winter. They give birth in early June, in time for them and their calves to feed on tender, new, green vegetation when they need it most.

As the Arctic warms, however, green-up is happening earlier than in the past. If caribou cannot find proper nourishment for themselves and their calves at this critical time, it may effect the health and future of the herd.

Caribou cow with her newborn calf

In early spring, a long line of caribou migrate north toward their summer calving range.

U.S. Department of the Interior
U.S. Fish & Wildlife Service

ANWR, the Arctic National Wildlife Refuge, is a conservation area in northeast Alaska managed by the U.S. Fish and Wildlife Service and owned by all Americans.

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arctic_refuge@fws.gov

http://arctic.fws.gov
www.facebook.com/arcticnationalwildliferefuge

August 2012
Photos by USFWS unless indicated otherwise

**From:** Leonetti, Crystal
**To:** Fox, Joanna
**Cc:** Arthur, Stephen
**Subject:** Re: ANWR photo
**Date:** Tuesday, November 14, 2017 10:23:16 AM
**Attachments:** image001.png

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Actually, I think one of the photos Steve sent will do the trick. I have what I need. Thanks Joanna!

*Crystal Leonetti*
Alaska Native Affairs Specialist
Alaska Region - R7 External Affairs **tEAm**
U.S. Fish & Wildlife Service
1011 E. Tudor Road
Anchorage, AK 99503

Direct: 907-786-3868
Mobile: 907-230-8419

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On Mon, Nov 13, 2017 at 3:46 PM, Leonetti, Crystal <crystal_leonetti@fws.gov> wrote:

> Hi Doug and Steve,
> Do you have any photos handy that would work for a very reliable Alaskan Associated Press journalist?
> Thanks!
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---------- Forwarded message ----------
From: **Joling, Dan** <djoling@ap.org>
Date: Mon, Nov 13, 2017 at 3:02 PM
Subject: ANWR photo
To: "Crystal_Leonetti@fws.gov" <Crystal_Leonetti@fws.gov>

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Thanks,

Dan

**Dan Joling**

**Newsman**

**The Associated Press, Anchorage**

**(907)-272-7549, office**

**(907)-223-2111, cell**

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<pch and beaver.jpg>

<pch1.jpg>

<pch2.jpg>


AP

**From:** Leonetti, Crystal
**To:** Joling, Dan
**Cc:** Andrea Medeiros
**Subject:** Re: ANWR photo
**Date:** Tuesday, November 14, 2017 10:33:21 AM
**Attachments:** image001.png

---

Hi Dan,

See attached photos. Will these do the trick?

*Crystal Leonetti*
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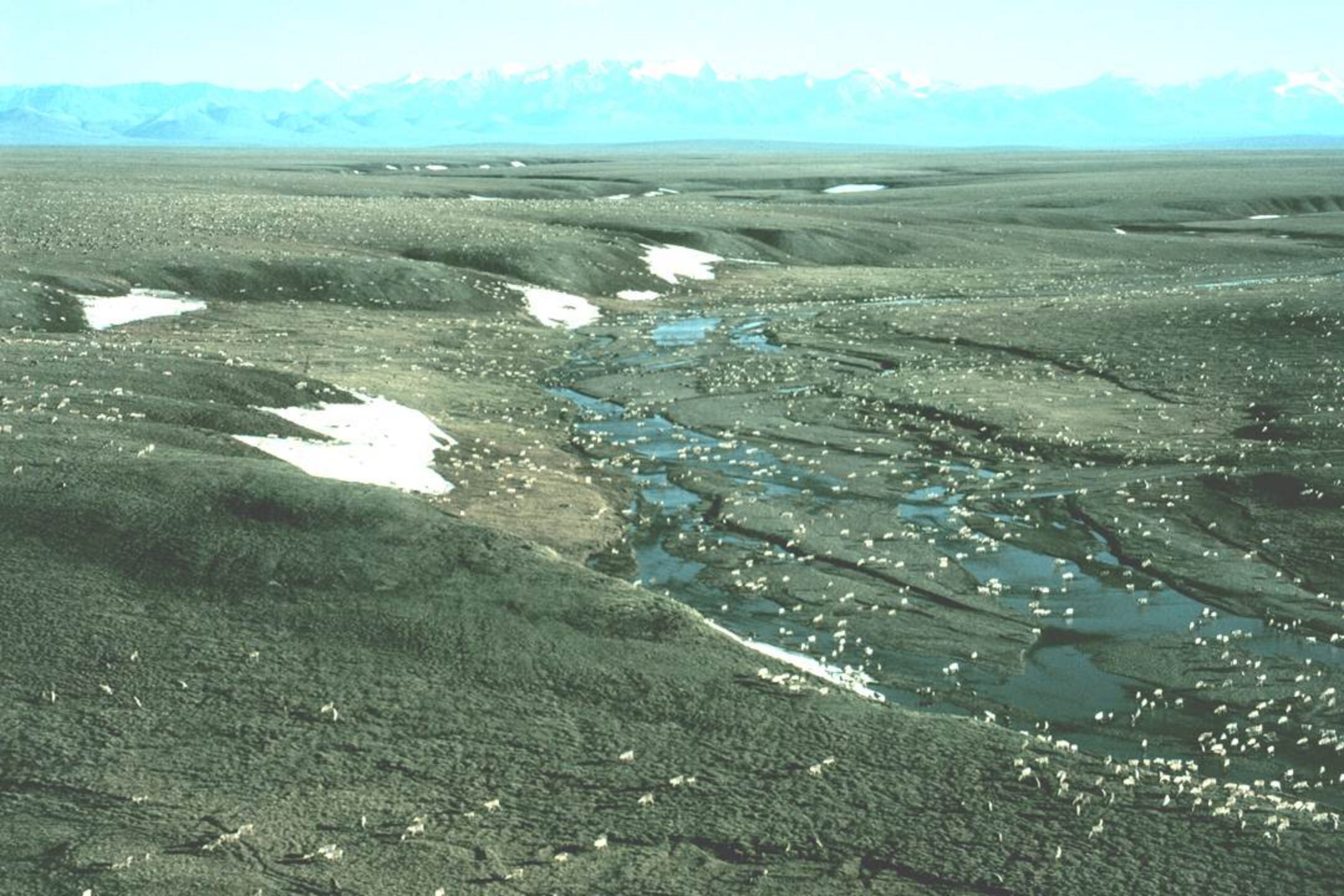


AP

**From:** Fox, Joanna
**To:** Leonetti, Crystal
**Cc:** Arthur, Stephen
**Subject:** Re: ANWR photo
**Date:** Tuesday, November 14, 2017 10:34:48 AM
**Attachments:** image001.png

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Here are a few more. I think if he's interested we have them in higher resolution - they're just too high to send via email (would have to use Google Drive).


_____
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Subject: ANWR photo
To: "[Crystal_Leonetti@fws.gov](mailto:Crystal_Leonetti@fws.gov)" <[Crystal_Leonetti@fws.gov](mailto:Crystal_Leonetti@fws.gov)>

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**(907)-272-7549, office**

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<pch and beaver.jpg>

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<pch2.jpg>


AP

**From:** Fox, Joanna
**To:** Leonetti, Crystal
**Cc:** Arthur, Stephen
**Subject:** Re: ANWR photo
**Date:** Tuesday, November 14, 2017 10:36:27 AM
**Attachments:** image001.png

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**To:** Fox, Joanna
**Subject:** Re: ANWR photo
**Date:** Tuesday, November 14, 2017 10:37:23 AM
**Attachments:** image001.png

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[IP_US_DISC]



<pch and beaver.jpg>

<pch1.jpg>

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**From:** Arthur, Stephen
**To:** Leonetti, Crystal
**Subject:** Re: ANWR photo
**Date:** Tuesday, November 14, 2017 10:45:34 AM
**Attachments:** image001.png

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Yes, that's fine,  except my last name is spelled "Arthur".

Steve

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**Subject:** Re: ANWR photo
**Date:** Tuesday, November 14, 2017 11:33:05 AM
**Attachments:** image001.png

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Crystal,

Regarding the caption for the photo of the Beaver flying over the Porcupine herd: that is an Alaska Dept of Fish and Game aircraft conducting a photo census of the herd on the coastal plain.

Steve

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> Crystal,
>
> I am working remotely so I do not have access to the Refuge photo library. I do have a couple of similar images on my computer (attached). The two ground-level photos (pch1 and pch2) are FWS file images; the aerial photo (pch and beaver) is one of my own.
>
> Perhaps someone at the Refuge can find the specific images from the brochure.
>
> Steve
>
> Stephen M. Arthur, Ph.D.
> *Supervisory Wildlife Biologist*
> *Arctic National Wildlife Refuge*
> *101 12th Ave., Room 236*
> *Fairbanks, AK 99701*
> *(907)455-1830*
>
> On Mon, Nov 13, 2017 at 4:08 PM, Leonetti, Crystal <crystal_leonetti@fws.gov> wrote:
>
> > Dan Joling says, of the attached document:
> >
> > > Crystal,
> > >
> > > We like the photo on page 3 of the caribou with the mountains in the background. The one that says "Wildlife" in the upper right-hand corner.
> > >
> > > We also like the one on page 7: the aerial view that shows thousands of caribou about he size of rice grains.
> > >
> > > Thanks much.
> > >
> > > I'm leaving now but will speak to you or Andrea on Tuesday.
> > >
> > > Dan
> >
> > *Crystal Leonetti*
> > Alaska Native Affairs Specialist
> > Alaska Region - R7 External Affairs tEAm
> > U.S. Fish & Wildlife Service
> > 1011 E. Tudor Road
> > Anchorage, AK 99503
> >
> > Direct: 907-786-3868
> > Mobile: 907-230-8419
> >
> > "Consultation is a process that aims to create effective collaboration with Indian tribes and to inform Federal

decision-makers. Consultation is built upon government-to-government exchange of information and promotes enhanced communication that emphasizes trust, respect, and shared responsibility. Communication will be open and transparent without compromising the rights of Indian tribes or the government-to-government consultation process." –S.O. 3317 (Department of the Interior Policy on Consultation with Indian Tribes)

On Mon, Nov 13, 2017 at 3:46 PM, Leonetti, Crystal <crystal_leonetti@fws.gov> wrote:

> Hi Doug and Steve,
> Do you have any photos handy that would work for a very reliable Alaskan Associated Press journalist?
> Thanks!
> *Crystal Leonetti*
> Alaska Native Affairs Specialist
> Alaska Region - R7 External Affairs tEAm
> U.S. Fish & Wildlife Service
> 1011 E. Tudor Road
> Anchorage, AK 99503
>
> Direct: 907-786-3868
> Mobile: 907-230-8419
>
> "Consultation is a process that aims to create effective collaboration with Indian tribes and to inform Federal decision-makers. Consultation is built upon government-to-government exchange of information and promotes enhanced communication that emphasizes trust, respect, and shared responsibility. Communication will be open and transparent without compromising the rights of Indian tribes or the government-to-government consultation process." –S.O. 3317 (Department of the Interior Policy on Consultation with Indian Tribes)
>
> ---------- Forwarded message ----------
> From: **Joling, Dan** <djoling@ap.org>
> Date: Mon, Nov 13, 2017 at 3:02 PM
> Subject: ANWR photo
> To: "Crystal_Leonetti@fws.gov" <Crystal_Leonetti@fws.gov>
>
> Hi Crystal,
>
> Just got an automatic email from Andrea saying she'd out of the office.
>
> We're looking for an agency photo of caribou on the coastal plain of ANWR.
>
> I looked in the USFWS digital archives and the selection is pretty limited, which makes me think I'm not very skilled at using your archives.
>
> The Washington Post had a photo of caribou on the plain with the Brooks Range in the background. I didn't see it in the digital archives. Am I looking in the wrong place? Can you help?
>
> Thanks,

Dan

**Dan Joling**

**Newsman**

**The Associated Press, Anchorage**

**(907)-272-7549, office**

**(907)-223-2111, cell**


AP

| | |
|---|---|
| **From:** | Miller, Susanne |
| **To:** | Leonetti, Crystal |
| **Cc:** | James Wilder; Michelle StMartin; Ryan Wilson |
| **Subject:** | Re: ABC News Terminology Question RE: Threatened vs Endangered |
| **Date:** | Tuesday, November 14, 2017 11:51:02 AM |
| **Attachments:** | Atwood etal_land use_SB_PLoS1_16.pdf<br>Koski et al. 2005 (Kaktovik Harvest) JCRM 7(1) 33-38.pdf<br>Schliebe et al. 2008.pdf<br>Wilson_etal2017.pdf |

---

As Jim said, humans and polar bears have both used Barter Island for as long as we know. In more "recent" times, one source (Arctic NWR Coastal Plain Resource Assessment, 1987) indicates that polar bears have sometimes aggregated at Barter Island since at least the mid-1980's. Similarly, Jacobson and Wentworth (1982) relate the availability of polar bears for subsistence harvest near the village in more recent years to the presence of whale carcasses and/or the dump.

Some other key scientific findings:

Koski et al (2005): Whale harvest records indicate that since about the early 1970s, one or more whales have been harvested at Barter almost every year (and presumably whale carcasses have been available to bears each of those years as well)

Schliebe et al. (2008): during aerial surveys flown along the Beaufort Sea coast in 2000-2005, polar bear density was higher in areas where subsistence -harvested whale carcasses were present; highest proportion (about 70%) was observed at Barter Island. The spatial distribution (location) of bears on shore also co-incided with the areas where the distance to ice edge was shortest, and where a higher seal density occurred. In other words, Barter Island is a location where bears can not only avoid fasting when on land during the open water season, it is also an area where they have earlier access to ringed seals once landfast ice forms.

Wilson et al. (2017) also found that polar bear distribution on shore was most strongly influenced by subsistence whaling activities (presence/absence of a carcass(es). Other factors included the presence/absence of barrier islands, and sea ice conditions (date of sea ice retreat and return).

Atwood et al. (2016) found that the percentage of radio-collared adult females coming ashore has increased in the last 15 years (since about 2000), and that they are arriving earlier, staying longer once on shore.

So one way to discuss the overlap between bears and humans at Barter would be something like:

**While polar bears and humans have overlapped in their use of the Barter Island area for centuries, the presence of whale carcasses near Kaktovik in association with subsistence whaling has been reliable since at least the early 1970s, and appears to be a primary factor influencing where bears are located once they come to shore.**

Sorry for delay in getting this to you; I hope this helps. Please let me know if ABC want copies of additional citations (I have attached the ones I have as .pdfs)

Susanne (Susi) Miller, Wildlife Biologist, Polar Bears
U.S. Fish and Wildlife Service
Marine Mammals Management
1011 E. Tudor Road, MS-341
Anchorage, AK 99503
Tel. 907-786-3828
Fax 907-786-3816

On Mon, Nov 13, 2017 at 11:29 AM, Leonetti, Crystal <crystal_leonetti@fws.gov> wrote:

> Susi,
> Can you help me answer this question? (copying others in case you're unable to get to it quickly)
> *Crystal Leonetti*
> Alaska Native Affairs Specialist
> Alaska Region - R7 External Affairs tEAm
> U.S. Fish & Wildlife Service
> 1011 E. Tudor Road
> Anchorage, AK 99503
>
> Direct: 907-786-3868
> Mobile: 907-230-8419
>
> "Consultation is a process that aims to create effective collaboration with Indian tribes and to inform Federal decision-makers. Consultation is built upon government-to-government exchange of information and promotes enhanced communication that emphasizes trust, respect, and shared responsibility. Communication will be open and transparent without compromising the rights of Indian tribes or the government-to-government consultation process." –S.O. 3317 (Department of the Interior Policy on Consultation with Indian Tribes)
>
> ---------- Forwarded message ----------
> From: **Dawson, Durrell** <Durrell.Dawson@abc.com>
> Date: Mon, Nov 13, 2017 at 11:21 AM
> Subject: RE: ABC News Terminology Question RE: Threatened vs Endangered
> To: "Leonetti, Crystal" <crystal_leonetti@fws.gov>
>
> Thanks Crystal,
>
> And one more question for your team… do we know how long polar bears and humans have been in Kaktovik/Barter Island together?
>
> James Wilder referenced the best available info and local knowledge from elders saying the polar bears were always present along the coast and around Kaktovik, but I'm wondering if we have any general idea range… like has it been just decades or centuries that both have been sharing the region? Thanks,

Durrell

**From:** Leonetti, Crystal [mailto:crystal_leonetti@fws.gov]
**Sent:** Monday, November 13, 2017 2:54 PM
**To:** Dawson, Durrell <Durrell.Dawson@abc.com>
**Subject:** Re: ABC News Terminology Question RE: Threatened vs Endangered

Hi Durrell,

Yes, Polar Bears are designated as threatened under the Endangered Species Act, and the Act says that a "threatened designation" means that the species is "likely to become endangered in the foreseeable future."

We are excited to see our people represented well on National news!

Crystal

*Crystal Leonetti*

Alaska Native Affairs Specialist

Alaska Region - R7 External Affairs tEAm

U.S. Fish & Wildlife Service

1011 E. Tudor Road

Anchorage, AK 99503

Direct: 907-786-3868

Mobile: 907-230-8419

"Consultation is a process that aims to create effective collaboration with Indian tribes and to inform Federal decision-makers. Consultation is built upon government-to-government exchange of information and promotes enhanced communication that emphasizes trust, respect, and shared responsibility. Communication will be open and transparent without compromising the rights of Indian tribes or the government-to-government consultation process." –S.O. 3317 (Department of the Interior Policy on Consultation with Indian Tribes)

On Mon, Nov 13, 2017 at 8:37 AM, Dawson, Durrell <Durrell.Dawson@abc.com> wrote:

> Hi Crystal,
>
> Just a quick question about the correct terminology that we should be using to refer to polar bears endangered species status… is "threatened" the same thing as "endangered" or does it just mean that they are more likely to become endangered in the future? Just want to make sure we have this distinction correct. Thanks,
>
> Durrell
>
> **From:** Leonetti, Crystal [mailto:crystal_leonetti@fws.gov]
> **Sent:** Monday, November 06, 2017 8:22 PM
> **To:** Dawson, Durrell <Durrell.Dawson@abc.com>
> **Cc:** Andrea Medeiros <andrea_medeiros@fws.gov>
> **Subject:** Fwd: Permafrost - Kaktovik
>
> Hi Durrell,
>
> Attached are 3 papers and a recent newspaper article about ice cellars and permafrost. Below, see our scientist's response to your questions.
>
> Permafrost is frozen soil, both near the surface and deeply buried. The Osterkamp paper provides data showing that the temperature of the permafrost on Barter Island has gotten warmer. When people say the permafrost is melting, what they mean is that just the top layer melts in summer, not all the deep permafrost. The ground is a frozen block of ice in winter. In summer, a layer at the top thaws back from the top. During warm summers the thawed layer is thicker. Water probably flows into the ice cellars. Summers are warmer now, so the summer thawed layer is getting thicker. In fall, it freezes back up to the surface again.
>
> Regarding the second question, a number of studies show that coastal erosion rates on the north coast have increased since the 1970s and it is attributed to decreasing sea ice during the summer months. Most erosion happens during a few large storms with strong wind and waves. The only steep banks I know of on Barter Island are along coast or maybe along shore of lake, so the question in your email must have been about coastal banks. So the answer is that, yes, they are eroding faster now than before. The soil on Barter Island is full of huge wedges of ice. You can see the ice in places as you walk along the beach

looking up at the bluffs. Once the ice is exposed to the air it melts rapidly. So the water does not have to be in contact with the ice to melt it. The sea water eats away at the bluff at the bottom, the bluff sluffs off and ice wedges high above the water are exposed to the air and start to melt.

Janet C. Jorgenson

Botanist

Arctic National Wildlife Refuge

101 12th Ave, Rm 236

Fairbanks, Alaska 99701

PLOS | ONE

RESEARCH ARTICLE

# Rapid Environmental Change Drives Increased Land Use by an Arctic Marine Predator

**Todd C. Atwood[1]*, Elizabeth Peacock[1], Melissa A. McKinney[2], Kate Lillie[3], Ryan Wilson[4], David C. Douglas[5], Susanne Miller[4], Pat Terletzky[3]**

**1** U.S. Geological Survey, Alaska Science Center, 4210 University Drive, Anchorage, AK, 99508, United States of America, **2** University of Connecticut, Center for Environmental Sciences and Engineering and Department of Natural Resources and the Environment, 1376 Storrs Road, Storrs, CT, 06269, United States of America, **3** Utah State University, Department of Wildland Resources, Logan, UT, 84322–5230, United States of America, **4** U.S. Fish and Wildlife Service, Marine Mammals Management, 1011 E Tudor Road, Anchorage, AK, 99503, United States of America, **5** U.S. Geological Survey, Alaska Science Center, 250 Egan Drive, Juneau, AK, 99801, United States of America

* tatwood@usgs.gov



OPEN ACCESS

**Citation:** Atwood TC, Peacock E, McKinney MA, Lillie K, Wilson R, Douglas DC, et al. (2016) Rapid Environmental Change Drives Increased Land Use by an Arctic Marine Predator. PLoS ONE 11(6): e0155932. doi:10.1371/journal.pone.0155932

**Editor:** Songhai Li, Institute of Deep sea Science and Engineering, Chinese Academy of Sciences, CHINA

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**Published:** June 1, 2016



**Data Availability Statement:** Data will be available from the US Geological Survey data portal at http://alaska.usgs.gov/portal/.

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## Abstract

In the Arctic Ocean's southern Beaufort Sea (SB), the length of the sea ice melt season (i.e., period between the onset of sea ice break-up in summer and freeze-up in fall) has increased substantially since the late 1990s. Historically, polar bears (*Ursus maritimus*) of the SB have mostly remained on the sea ice year-round (except for those that came ashore to den), but recent changes in the extent and phenology of sea ice habitat have coincided with evidence that use of terrestrial habitat is increasing. We characterized the spatial behavior of polar bears spending summer and fall on land along Alaska's north coast to better understand the nexus between rapid environmental change and increased use of terrestrial habitat. We found that the percentage of radiocollared adult females from the SB subpopulation coming ashore has tripled over 15 years. Moreover, we detected trends of earlier arrival on shore, increased length of stay, and later departure back to sea ice, all of which were related to declines in the availability of sea ice habitat over the continental shelf and changes to sea ice phenology. Since the late 1990s, the mean duration of the open-water season in the SB increased by 36 days, and the mean length of stay on shore increased by 31 days. While on shore, the distribution of polar bears was influenced by the availability of scavenge subsidies in the form of subsistence-harvested bowhead whale (*Balaena mysticetus*) remains aggregated at sites along the coast. The declining spatio-temporal availability of sea ice habitat and increased availability of human-provisioned resources are likely to result in increased use of land. Increased residency on land is cause for concern given that, while there, bears may be exposed to a greater array of risk factors including those associated with increased human activities.

**Competing Interests:** The authors have declared that no competing interests exist.

## Introduction

The long-term persistence of polar bears (*Ursus maritimus*) is linked to the health of the Arctic marine ecosystem, particularly the availability of sea-ice habitat [1, 2]. Polar bears are specialist carnivores that rely on sea ice to meet a number of life history needs including accessing prey, searching for mates, and establishing maternal dens [3]. However, the Arctic region is experiencing a warming trend that is driving pronounced changes in sea ice extent and structure. Since 1979, sea ice extent and volume during summer have declined at rates of ≈14%/ and 28%/decade [4], respectively, with the most pronounced change occurring over the last 15 years. Arctic warming will likely continue for several decades given the current trends in global greenhouse gas emissions [5] and the lag times associated with global climate processes attaining equilibrium [6]. Hence, climate-induced effects on sea ice and polar bears will continue for several decades, or longer, if global greenhouse gas emissions are not reduced.

The ability of individuals to modify their behavior has been posited as the primary mechanism by which some animal populations have responded to climate-driven changes in their environment [7]. The best documented examples of behavioral modification in response to altered physical environments have involved changes in spatial distribution and phenological shifts (i.e., the seasonal timing of animal and plant activities, sensu [8]). For example, Perry et al. [9] documented northward shifts in distribution for a group of North Sea fishes in response to increased sea temperature. Parmesan and Yohe [10] examined over 800 terrestrial species and detected distributional shifts in approximately half: 80% of those shifts were poleward with most being influenced by the advancement of the spring season. However, species that occur at environmental extremes, such as Arctic endemics, have little opportunity to modulate climate-warming changes to their physical environment via shifts in distribution. Rather, they must display *in situ* plasticity in key behaviors or traits to cope with a changing climatic envelope.

For a habitat specialist with a long generation time such as the polar bear, the rapidly changing physical environment can create a situation where the species becomes "trapped" by its evolved response to cues that are suddenly occurring in a novel context (e.g., [11]). As a result, entrenched behaviors could become maladaptive and eventually manifest at the population level as declining vital rates—unless the species possesses sufficient phenotypic plasticity to assess and respond to highly dynamic conditions. For polar bears, there is uncertainty concerning their capacity to exhibit behavioral plasticity relative to changing sea ice phenology and availability, particularly in areas of the Arctic where bears have historically spent the entire year on the sea ice. In those areas, the decision to remain with ice as it retreats well past biologically-productive shallow waters may lead to prey scarcity and nutritional restriction [12]. By contrast, the decision to displace from retreating sea ice to shore could result in attraction to habitats that function as ecological traps because they contain inadequate resources or expose bears to novel risk factors. Understanding how polar bears respond to climate-driven displacement from primary habitat, and how this overlaps with exposure to known and novel threats, is critical to forecasting how they may fare in an increasingly dynamic environment.

Polar bears of the southern Beaufort Sea (SB) subpopulation have historically spent the entire year on the sea ice (with the exception of individuals that den on land), even when the pack ice retreated away from the coast to its minimal extent in September [1, 13]. However, over the last 15 years, the SB has experienced a marked decline in September sea ice extent, along with a pronounced lengthening of the melt season (i.e., period of time between sea ice break-up and freeze-up; [14]). The dramatic changes in the extent and phenology of sea ice habitat have coincided with evidence suggesting that use of terrestrial habitat has increased. For example, Schliebe et al. [15] estimated that between 3.7 and 8.0% of polar bears from the

SB were on land in a given autumn during 2000–2005, and that percentage increased when sea ice was farthest from the coast. In contrast to the SB, polar bears of the greater Hudson Bay region [16], for example, historically spent significant periods of time on land (1–5 months) when ice completely melted each year. In general, populations in the Hudson Bay region have been demographically productive [17, 18, 19], although an increase in the length of the ice-free season has resulted in a decline in the western Hudson Bay (WH) subpopulation [20, 21] followed later by apparent stabilization [22]. In the SB, measured declines in polar bear body condition, productivity, and abundance have also been linked to declining sea ice habitat [13, 23, 24, 25, 26]. It is unknown if the decline in productivity in the SB subpopulation is linked to increased use of land or to remaining on the sea ice as it retreats away from the biologically productive water of the continental shelf.

Here, we investigated polar bears from Alaska's SB subpopulation, where rapid environmental change may be driving a divergence in space use and foraging behaviors in the form of increased land use. Specifically, our objectives were to examine (i) the long-term trend in the use of terrestrial habitat, (ii) the influence of sea ice characteristics on the phenology of movement from sea ice to terrestrial habitats and back to ice, and (iii) the spatial distribution of bears while on shore. Last, we discuss potential cascading effects of behavioral divergence and how those effects may influence population dynamics in the SB through time.

## Materials and Methods

### Ethics Statement

This research was approved under the Marine Mammal Protection Act and Endangered Species Act with U.S. Fish and Wildlife Service (USFWS) permit number MA690038. Capture protocols were approved by the U.S. Geological Survey (USGS) Institutional Animal Care and Use Committee.

### Study Area

The study area ranged from Baillie Island, Canada, (70.5°N, 128° W) in the east, to Point Barrow, USA, (71°N, 156° W) in the west (Fig 1a and 1b). The SB is characterized by a narrow, biologically-productive continental shelf with bathymetry contours typically $\leq$ 300m, and with an abrupt shelf-break that quickly gives way to some of the deepest waters of the Arctic Ocean [27].

The SB coastal region is characterized by an industrial footprint associated with oil and gas exploration and extraction activities causing polar bears that frequent this area to be potentially exposed to industrial activities [28]. The Prudhoe Bay and Kuparuk oil fields are situated at the approximate midpoint along the coast, and the National Petroleum Reserve-Alaska (NPR-A) spans a significant stretch of the western portion of the coastal plain, though there is no significant industrial development within the NPR-A. There are 3 communities within the study area that harvest bowhead whales (*Balaena mysticetus*) in the fall: Barrow, Nuiqsut, and Kaktovik. Remains from the harvest have been sporadically aggregated at Point Barrow and consistently aggregated at Cross Island and Barter Island, all of which are nearly evenly spaced along the coast where they have served as focal attractors for polar bears [15].

### Data Collection

Polar bear research in the SB has been ongoing for over 30 years, and we used both historical and contemporary data sets to investigate whether use of land has changed over time. Since the mid-1980s, polar bears have been captured on the sea ice (up to 160 km from the coast) nearly every spring. Polar bears were encountered opportunistically from a helicopter and

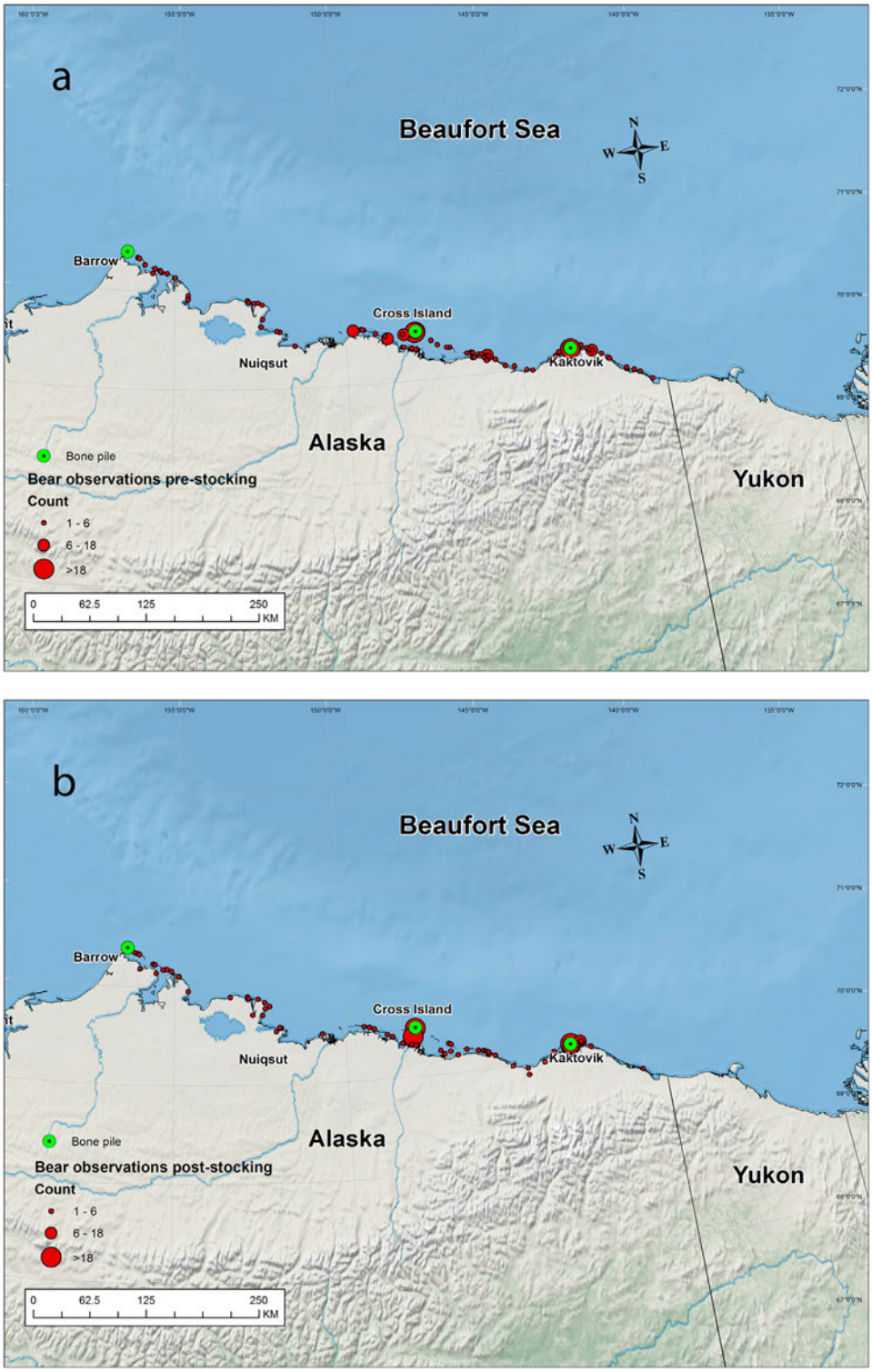


**Fig 1.** a-b. Spatial distribution of polar bears observed during fall aerial surveys, 2010–2013, along the coast and over barrier islands prior to the stocking of bowhead whale bone piles with remains from the subsistence harvest. Unused remains from subsistence-harvested bowhead whales are occasionally aggregated at sites on Point Barrow, and consistently at Cross Island (near Prudhoe Bay), and adjacent to Kaktovik on Barter Island following the cessation of the fall whaling season.

doi:10.1371/journal.pone.0155932.g001

immobilized with the drugs sernylan or phencyclidine (prior to 1987) and tiletamine hydrochloride plus zolazepam hydrochloride (1987–2014; Telazol®, Fort Dodge and Warner-Lambert Co.) using a projectile syringe fired from a dart gun. A subset of adult females was fitted with either Argos or global positioning system (GPS) Platform Transmitter Terminal (PTT) satellite radio collars [13]. Age was determined by multiple methods. Cubs-of-the-year (COY) were always with their mothers and could be visually aged without error [29]. Some bears had been captured and marked in previous years, so their age was determined from their capture history. For new captures, we extracted a vestigial premolar tooth and determined age by analysis of cementum annuli [30].

## Phenology of onshore behavior

We used location data from radiocollared adult females from 1986 to 2014 to determine if bears used terrestrial habitat during summer and, if so, to generate estimates of mean date of arrival on shore, duration of time spent on shore, and mean date of departure from shore back to the sea ice. The majority of locations prior to 2010 were derived with the Argos System, and have variable levels of accuracy from $< 250$ m to $> 1500$ m (see http://www.argos-system.org/web/en/78-faq.php#faq-theme-55). We filtered locations in an attempt to remove spurious locations by first removing all designations which had a high probability of being erroneous. We then applied the Douglas Argos-Filter algorithm [31] using a maximum redundancy function set at 10 km and minimum rate ("minrate") of movement set at 10 km/hr.

To integrate the GPS and filtered Argos location data, which varied both in accuracy and the temporal scale of collection, we employed the continuous time correlated random walk (CRAWL) model [32] to develop predicted paths at a regularized daily time interval based on observed locations. The CRAWL model allows predicted paths to take into account variable location quality and sampling intervals. Thus, for Argos locations, we defined location accuracy based on accuracy designations for Telonics Argos collars (i.e., L3: 150 m, L2: 350 m, L1: 1000 m, L0: 1500 m; http://www.telonics.com/technotes/argosintro.php). Because location accuracies are not provided for locations with LA or LB designations, we provided conservative location accuracies; LA: 5,000 m, LB: 10,000 m. We assigned locations obtained from GPS collars an accuracy of 30 m.

Based on the observed location accuracy and land use, we used the R [33] package 'crawl' [31] to implement the CRAWL model and predict daily polar bear locations from 1 July to 31 October period. We then associated predicted locations with buffered land coverages (described below) to determine if an animal was likely to be on land at that time. Because the CRAWL model does not provide meaningful results if observed locations are too temporally dispersed [34], we excluded predicted locations that occurred between observed points separated by $>14$ days. For bears that came ashore, we noted the ordinal date of arrival and departure, and calculated the total amount of time spent on shore. We then generated indices of the earliest and mean ordinal dates of arrival on shore, mean departure back to the sea ice, and length of stay on shore.

We determined if an animal's location occurred on land by overlaying locations on one of two land coverages. The first layer was a digital elevation model (100 m resolution; http://data.eol.ucar.edu/codiac/dss/id=106.ARCSS301; accessed 12 Aug 2014) for the North Slope of Alaska. While this layer covered the majority of land used by bears in this study, it did not provide coverage for eastern Canada. Thus, to account for land use in that region, we used the default continent shapefile found in ArcGIS (version 10.1, ESRI, Redlands, CA). Because neither land coverage had sufficient resolution to detect small barrier islands, which are known to receive significant use by polar bears during summer [35], we buffered the land coverages by 5

km. We then determined which animal locations occurred within the 5 km land buffer and categorized those as predicted land locations. While this might have resulted in some bears not on land being classified as using land, this was unlikely to occur given that landfast ice is largely absent during this period. Thus, any animal observed within this buffer would most likely have used land at some point during that day.

## Sea ice characteristics

Polar bears in the SB prefer sea ice habitat over the continental shelf because it provides greater accessibility to prey than the deeper water of the polar basin [13]. We hypothesized that the phenology of land use was influenced by sea ice characteristics, including the distance between the continental shelf break and the edge of the pack ice and the concentration of ice over the shelf. We used daily sea ice data from the National Snow and Ice Data Center (NSIDC; Boulder, Colorado, USA) to develop concentration and distance metrics. Sea ice concentrations were estimated from a 25 × 25 km resolution raster of passive microwave satellite imagery [36]. For the months of July through October, we estimated a number of metrics including sea ice concentrations over the continental shelf, distances from the shelf break to pack ice, the timing of break-up and freeze-up, and length of the open-water season (see Table 1 for a list of sea ice metrics). Shelf break and shelf area were delineated by the 300 m isobath for the offshore region within the boundary of the SB polar bear subpopulation [1]. We defined areas covered by sea ice with two criteria based on different ice concentration thresholds, >15% and >50%. We then generated daily estimates of the proportion of the continental shelf area covered by >15 or 50% sea ice concentration, and the mean distance between the shelf break and the ice pack, where ice pack was comprised by ice concentrations >15 or 50%. We chose to use ice metrics based on both thresholds because >50% is most commonly cited as the threshold above which sea ice habitat is most suitable for polar bears [20], while break-up and freeze-up are often defined as the time when ≥15% concentration sea ice melts or refreezes [14]. Additionally, because the SB is characterized by a narrow continental shelf, we hypothesized that bears may remain over the productive shelf even as ice concentrations drop below 50%.

## Distribution

When polar bears of the SB come ashore, they mostly stay within a narrow band of the coast or on barrier islands [15]. From 2010 to 2013 we conducted transect-based aerial surveys twice (≤ 3 weeks apart) each fall along the coast between Point Barrow and the U.S.A.-Canada border to characterize distribution. In fall, polar bears are easy to detect when on land because of the contrast between the colors of bears and the snow- and ice-free substrate [37, 22]. Transects were 8-km in length and included segments oriented perpendicular to the coast line connected by alternating inland or coastal segments. We flew Bell 206B and Aerostar 305A helicopters at an altitude of ≈90 m and airspeed of ≈80 knots. In addition, total counts were conducted over every barrier island encountered, with the exception of Barter Island. The village of Kaktovik is located on Barter Island, and is adjacent to a bowhead whale carcass aggregation site which provides opportunities for commercial polar bear viewing. As such, we did not fly over Barter Island over concerns that helicopter activity would disturb commercial bear viewing ventures. We did, however, collect ground-based total counts of all bears present at the Barter Island carcass site and local vicinity on the same day as our aerial survey. We flew over carcass aggregation sites at Point Barrow and Cross Island, though no carcasses were present at Point Barrow in 2013. When we encountered a bear, we estimated age, sex, and group size, and collected a geographic location. We combined counts from transects and barrier islands to generate a total uncorrected minimum count for each of the two annual surveys and used the total counts to examine spatial distribution.

**Table 1. Description of sea ice variables used in the analysis of factors influencing the timing of arrival on shore, length of stay, and timing of departure back to sea ice by polar bears from the Southern Beaufort Sea subpopulation.**

| Variable | Description |
|---|---|
| FD≤15% | The first date (day of year) when the proportion of the continental shelf covered by >15% sea ice concentration decreased to ≤15%. |
| FD≤50% | The first date when the proportion of the continental shelf covered by >50% sea ice concentration decreased to ≤50%. |
| Shelf>15% wk | The mean proportion of the shelf covered by >15% concentration sea ice 1 week prior to arrival on shore. |
| Shelf>50% wk | The mean proportion of the shelf covered by >50% concentration sea ice 1 week prior to arrival on shore. |
| Mdis>15% wk | The mean distance (km) of >15% concentration sea ice from the continental shelf 1 week prior to arrival on shore. |
| Mdis>50% wk | The mean distance of >50% concentration sea ice from the continental shelf 1 week prior to arrival on shore. |
| OW15% | The duration (number of days) of the open-water season, defined as when the proportion of the continental shelf covered by >15% sea ice concentration decreases below ≤15%. |
| OW50% | The duration of the open-water season, defined as when the proportion of the continental shelf covered by >50% sea ice concentration decreases below ≤50%. |
| Shelf>15% OW | The mean proportion of the continental shelf covered by >15% concentration sea ice during the open water season. |
| Shelf>50% OW | The mean proportion of the continental shelf covered by >50% concentration sea ice during the open water season. |
| Mdis>15% OW | The mean distance of >15% concentration sea ice from the continental shelf during the open water season. |
| Mdis>50% OW | The mean distance of >50% concentration sea ice from the continental shelf during the open water season. |
| LD≤15% | The last date when the proportion of the continental shelf covered by >15% sea ice concentration was below ≤15%. |
| LD≤50% | The last date when the proportion of the continental shelf covered by >50% sea ice concentration was below ≤50%. |
| Shelf>15% depart | The mean proportion of the continental shelf covered by >15% concentration sea ice 1 week prior to departure from shore. |
| Shelf>50% depart | The mean proportion of the continental shelf covered by >50% concentration sea ice 1 week prior to departure from shore. |
| Mdis>15% depart | The mean distance of >15% concentration sea ice from the continental shelf 1 week prior to departure from shore back to sea ice. |
| Mdis>50% depart | The mean distance of >50% concentration sea ice from the continental shelf 1 week prior to departure from shore back to sea ice. |
| Year | Calendar year in which observations were collected. |

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## Analyses

We used a generalized additive mixed model (GAMM) with a binomial distribution to determine whether the percentage of radiocollared polar bears using land ≥21 consecutive days versus remaining on the sea ice changed over time. We chose the threshold of ≥21 consecutive days because it has been used previously [35, 38] to describe long-term use of land and thus allows for comparison to our study. Based on the previously described analysis of CRAWL-derived locations, we coded land use or lack thereof by individuals as a binary response variable (i.e., 1 = individual used land, 0 = individual did not use land). Year was analyzed as a fixed effect, but because some individual bears were radiocollared in multiple years, we used individual as a random factor. We also calculated the mean annual percentage of radiocollared bears

with long-term land use, and used a piecewise general linear regression procedure [39] with a normal distribution to determine if and when there was a discontinuity (i.e., breakpoint) in the mean annual percentage detected on shore over the 29 years of study. Parameters estimated for the piecewise regression included the intercept, change in slope prior to the breakpoint, and change in slope after the breakpoint [39]. We did not include collar type (Argos and GPS) as a variable in subsequent analyses, though it is possible that improvements in satellite collar technology could represent a confounding factor. However, while the ability to accurately estimate the true day of arrival on land and departure back to ice should be better with GPS-era collars, the Argos-era data should not be biased toward estimating either longer or shorter land tenures.

To determine the relationship between the phenology of onshore use by radiocollared bears and sea ice dynamics, we used linear mixed models to examine the influence of sea ice conditions and characteristics on the annual mean timing of arrival on shore, length of stay on shore, and timing of departure from shore back to the sea ice. For this analysis, we included bears that came ashore for $\geq$7 consecutive days and used ordinal dates of arrival and departure, and total days spent on shore as response variables. We used the $\geq$7 consecutive days threshold to exclude bears that used land incidentally. Because we sampled some of the same individuals repeatedly, we included individual identity as a random factor in the models with first-order autocorrelation as a covariance structure. We used restricted maximum likelihood (REML) methods for model estimation. When modeling timing of departure, we censored individuals that entered maternity dens on land. Predictor variables included measures of >15% and >50% sea ice concentrations over the continental shelf (e.g., Mn>15%, Mn>50%), distance from the shelf of >15% and >50% sea ice (Mdis>15%, Mdis>50%), and length of the open water season defined as the periods of time when sea ice concentration remained $\leq$15 or $\leq$50% (OW15%, OW50%).

We developed, *a priori*, sets of biologically plausible candidate models (S1 Table) and used Akaike's information criterion values [40] corrected for small sample bias ($AIC_c$) to aid in determining top models. We used $AIC_c$ to rank and compare models based on $\Delta AIC_c$ and normalized Akaike weights $w_i$ and considered models with $\Delta AIC_c$ values >2.0 to measurably differ in information content [41]. When faced with model uncertainty, we calculated 85% confidence intervals (CI) for parameter estimates to avoid unnecessarily discarding variables in models supported by lower $AIC_c$ values [42]. Following Arnold [42], we considered parameters whose 85% CI overlapped zero to be uninformative. We assessed multicollinearity of predictor variables using variance inflation factors (VIF) and removed a correlated variable from a given model when VIF >10 [43]. We used normal probability plots and coefficients of correlation to ensure that model variables were normally distributed and assessed fit using measures of model deviance [44].

We used the paired sets of annual aerial surveys to investigate whether the availability of bowhead whale remains influenced polar bear distribution. We pooled data among years from surveys conducted before and after whale remains were placed at carcass aggregation sites (Point Barrow, Cross Island, and Barter Island). We used Moran's I statistic to test the hypothesis that polar bear sightings were spatially autocorrelated (i.e., individuals were not randomly distributed) and an ArcGIS to determine the Euclidean distance of each bear sighting to the closest carcass aggregation site. We then used a Kolmogorov-Smirnov test to determine if the distribution of distances from carcass sites differed between survey sessions— i.e., whether the spatial distribution of bears differed prior to and after the stocking of carcass sites. Statistical significance for these tests was set at $\alpha = 0.05$.

## Results

During aerial surveys conducted in fall of 2010–2013 we flew a total of 9,820 ($\bar{x}$ = 1,226 ± 378 km) kilometers on transect and searched an average of 31 barrier islands to determine the

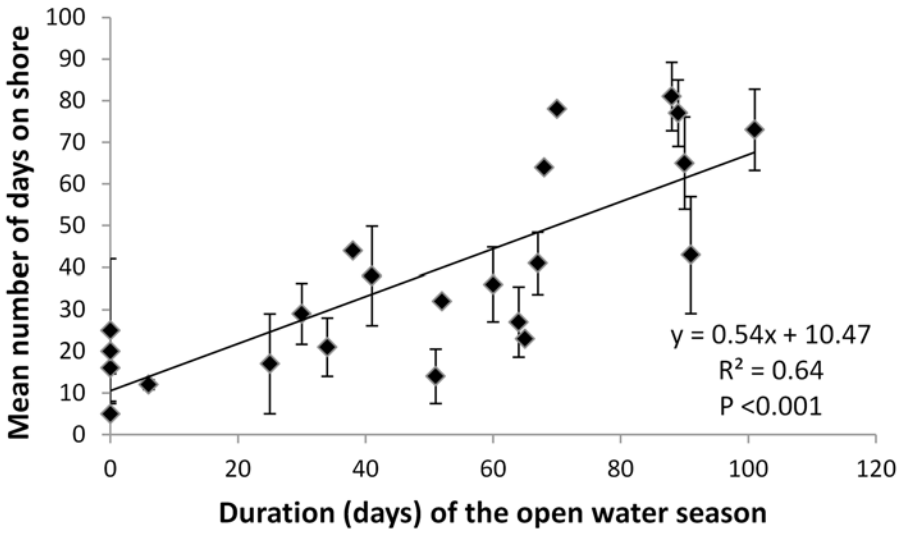


**Fig 2. Proportion of radiocollared adult female polar bears that spent ≥ 21 consecutive days on shore, 1986–2014.**

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spatial distribution of bears along the coast. From 1986 to 2014, a total of 389 radiocollars (satellite or GPS) were placed on 228 adult female polar bears. Results of the GAMM model indicated that the proportion of radiocollared bears coming ashore in summer and fall increased over the years ($\beta_{year}$ = 0.58, P = 0.004). Using piecewise regression, we detected a breakpoint in the percentage of radiocollared bears on shore for ≥21 days at the year 2000: the average percentage of bears on shore increased from 5.8% (SE = 0.02) during 1986–1999 to 20% (SE = 0.03) during 2000–2014, reaching a high of 37% in 2013 (Fig 2).

## Onshore phenology

Among all data, 68 radiocollared (39 satellite, 29 GPS) bears representing 46 individuals spent ≥7 days shore during the open water season, which were used to characterize onshore phenology. The piecewise regression indicated that the earliest date of arrival on shore by radiocollared bears differed between the two periods ($\bar{x}_{1986-1999}$ = 256 (i.e., 13 September), SE = 3.9; $\bar{x}_{2000-2014}$ = 241 (i.e., 29 August), SE = 3.1), ranging from 6 August in 1993 to 22 July in 2000. From 1986–1999, the mean length of stay on shore was 20 days (SE = 2.5 days); from 2000–2014, the mean length of stay on shore was 56 days (SE = 3.2 days). Date of departure also varied over the years, ranging from 14 August in 1993 to 7 November in 2013 ($\bar{x}_{1986-1999}$ = 275 (i.e., 2 October), SE = 5.3; $\bar{x}_{2000-2013}$ = 294 (i.e., 21 October), SE = 1.6).

Throughout the study, polar bear arrival on shore advanced at a rate of ~5 days/decade. The top model for predicting the date of arrival of bears on shore accounted for 87% of the total model set weight. Variables contained in the top model were ordinal date when sea ice concentration over the shelf dropped below 15% (FD≤15%; β = 0.369, SE = 0.06) and the proportion of the shelf covered by >15% concentration sea ice the week prior to arrival on shore (shelf>15% wk; β = -0.514, SE = 0.11) (Table 2). Examination of model coefficients indicated that earlier dates of <15% concentration sea ice over the shelf and increased availability of >15% concentration sea ice over the shelf resulted in earlier arrival of bears on land (Table 3). All other models for predicting the timing of arrival on shore had $\Delta AIC_c > 2$ (Table 2).

Over the course of the study, the total days spent on shore by polar bears increased by ~7 days/decade. The top model for predicting total days spent on shore by polar bears accounted

**Table 2. Model ID, explanatory variables, $AIC_c$ values, Akaike weights, and deviance for linear mixed models describing the timing of arrival of polar bears on shore, 1986–2014.**

| Model ID | Explanatory Variables | $AIC_c$ | Akaike Wt. ($w_i$) | Deviance |
|---|---|---|---|---|
| 4 | FD≤15%, Shelf>15% wk | 671.4 | 0.87 | 667.3 |
| 8 | FD≤15%, Shelf>15% wk, Mdis>15% wk, year | 676.2 | 0.07 | 672.1 |
| 7 | FD≤15%, Shelf>15% wk, Mdis>15% wk | 677.5 | 0.04 | 673.4 |
| 17 | Year | 686.5 | 0.01 | 682.4 |
| 1 | FD≤15% | 686.8 | <0.00 | 682.7 |
| 9 | FD≤50% | 690.5 | <0.00 | 686.4 |
| 6 | Mdis>15% wk, FD≤15% | 692.3 | <0.00 | 688.1 |
| 12 | FD≤50%, Shelf>50% wk | 692.7 | <0.00 | 688.6 |
| 16 | FD≤50%, Shelf>50% wk, Mdis>50% wk, year | 692.6 | <0.00 | 688.5 |
| 14 | Mdis>50% wk, FD≤50% | 697.4 | <0.00 | 693.3 |
| 10 | Shelf>50% wk | 697.9 | <0.00 | 693.8 |
| 2 | Shelf>15% wk | 699.8 | <0.00 | 695.7 |
| 15 | FD≤50%, Shelf>50% wk, Mdis>50% wk | 699.4 | <0.00 | 695.3 |
| 11 | Mdis>50% wk | 701.2 | <0.00 | 697.0 |
| 3 | Mdis>15% wk | 702.3 | <0.00 | 698.2 |
| 5 | Mdis>15% wk, Shelf>15% wk | 703.0 | <0.00 | 700.6 |
| 13 | Mdis>50% wk, Shelf>50% wk | 704.7 | <0.00 | 698.9 |

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for 74% of the model set weight and contained the mean distance of >15% concentration sea ice from the continental shelf during the open water season (Mdis>15% OW; β = 0.022, SE = 0.02), duration of the open water season (defined using the 15% threshold; OW15%; β = 0.334, SE = 0.11), and year (β = 0.907, SE = 0.48) (Table 4). Examination of model coefficients indicated that total number of days spent on shore increased with increasing distance of >15% sea ice from the shelf, duration of the open water season ($F_{61,14}$ = 8.90, P < 0.0001; Fig 3), and year. However, the 85% confidence interval for Mdis>15% OW overlapped zero, indicating the variable may be uninformative [42]. All other models for predicting the length of stay on shore had $\Delta AIC_c$ >2 (Table 4).

The top model for predicting the timing of departure of bears from shore back to the sea ice explained 77% of the model set weight and contained the proportion of the shelf covered by >15% concentration sea ice the week prior to departure (Shelf>15% depart; β = -0.158, SE = 0.11), the mean distance of >15% sea ice concentration from the shelf (Mdis>15% depart;

**Table 3. Response and explanatory variables, model rank, $AIC_c$ value, coefficient estimates, and 85% confidence intervals (CI) for the top general linear models describing the phenology of land use, 1986–2014.**

| Response | Model ID | Explanatory Variables | Mode Rank | Estimate (β) | S.E. | 85% CI lower | 85% CI upper | P-value |
|---|---|---|---|---|---|---|---|---|
| Arrival date | 4 | FD≤15% | 1 | 0.369 | 0.06 | 0.27 | 0.45 | <0.0001 |
| | | Shelf>15% wk | | -0.515 | 0.11 | -0.68 | -0.35 | <0.0001 |
| Length on shore | 7 | OW15% | 1 | 0.334 | 0.11 | 0.17 | -0.01 | 0.002 |
| | | Mdis>15% OW | | 0.022 | 0.02 | 0.01 | 0.07 | 0.22 |
| | | Year | | 0.907 | 0.48 | 0.19 | 1.62 | 0.06 |
| Departure date | 16 | Shelf>15% depart | 1 | -0.158 | 0.11 | -0.32 | 0.01 | 0.005 |
| | | Mdis>15% depart | | -0.118 | 0.02 | -0.15 | -0.09 | 0.21 |
| | | Year | | 1.059 | 0.36 | 0.52 | 1.59 | 0.03 |

doi:10.1371/journal.pone.0155932.t003

**Table 4. Model ID, explanatory variables, AIC and $AIC_c$ values, Akaike weights, and deviance for the linear mixed models describing the length of stay on shore, 1986–2014.**

| Model ID | Explanatory Variables | $AIC_c$ | Akaike Wt. ($w_i$) | Deviance |
|---|---|---|---|---|
| 7 | Mdis>15% OW, OW15%, year | 658.7 | 0.74 | 656.6 |
| 1 | OW15% | 662.5 | 0.11 | 658.3 |
| 15 | Year | 663.8 | 0.06 | 659.7 |
| 4 | Mdis>15% OW, OW15% | 664.6 | 0.04 | 660.4 |
| 13 | Shelf>50 OW, Mdis>50% OW, year | 666.0 | 0.02 | 663.9 |
| 14 | OW50%, Mdis>50 OW, year | 666.2 | 0.01 | 662.0 |
| 6 | Shelf>15 OW, Mdis>15 OW, year | 666.8 | 0.01 | 664.8 |
| 11 | Mdis>50 OW, OW50% | 673.5 | <0.00 | 669.3 |
| 8 | OW50% | 679.6 | <0.00 | 675.4 |
| 12 | Shelf>50 OW, Mdis>50 OW | 680.6 | <0.00 | 678.6 |
| 5 | Shelf>15 OW, Mdis>15 OW | 681.4 | <0.00 | 679.3 |
| 10 | Mdis>50 OW | 682.1 | <0.00 | 678.0 |
| 2 | Shelf>15 OW | 683.2 | <0.00 | 679.0 |
| 3 | Mdis>15 OW | 686.2 | <0.00 | 682.1 |
| 9 | Shelf>50 OW | 687.7 | <0.00 | 683.6 |

doi:10.1371/journal.pone.0155932.t004

β = -0.118, SE = 0.02), and year (β = 1.059, SE = 0.26) (Table 5). The 85% confidence interval for the proportion of the shelf covered by >15% concentration sea ice the week prior to departure overlapped zero, suggesting it may be an uninformative variable. All other models for predicting the timing of departure from shore back to sea ice had $\Delta AIC_c > 2$ (Table 5). Inspection of model coefficients indicated that decreased availability of >15% concentration sea ice, reduced distance of >15% sea ice from the shelf, and later year resulted in later departure of bears from shore back to sea ice. Comparison of $w_i$ for the first- and second-ranked models indicated that the first-ranked model was 4.5 times more likely to be the actual best model and deviance statistics indicated the top model best fit the data (Table 5). Over the duration of the study, departure from shore back to sea ice occurred approximately 7 days later/decade.

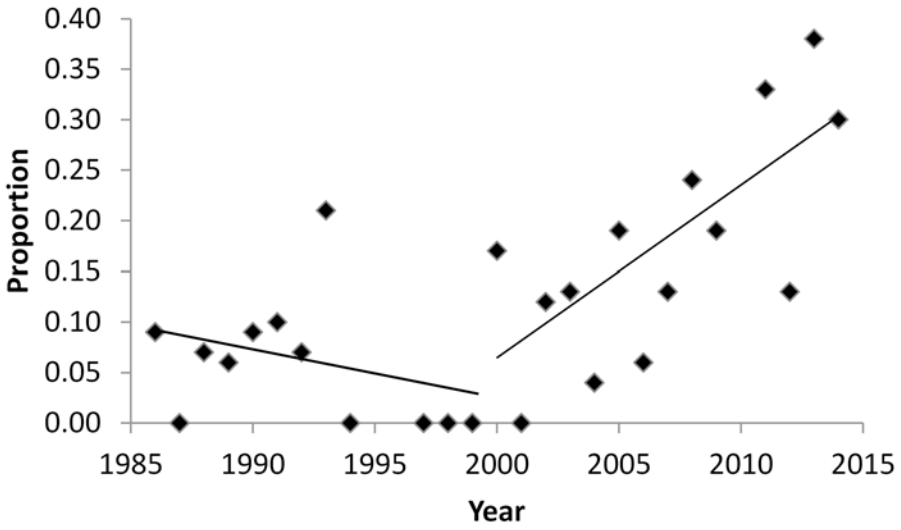


**Fig 3. Mean (and standard error) length of stay on shore relative to the length of the open water season, defined as when the proportion of the continental shelf covered by >15% sea ice concentration decreases below ≤15%.**

doi:10.1371/journal.pone.0155932.g003

**Table 5. Model ID, explanatory variables, AIC and $AIC_c$ values, Akaike weights, and deviance for the linear mixed models describing the timing of departure from shore back to sea ice, 1986–2014.**

| Model ID | Explanatory Variables | $AIC_c$ | Akaike Wt. ($w_i$) | Deviance |
|---|---|---|---|---|
| 7 | Shelf>15% depart, Mdis>15% depart, year | 527.2 | 0.77 | 525.1 |
| 16 | Shelf>50% depart, Mdis>50% depart, year | 530.2 | 0.17 | 528.1 |
| 13 | LD≤50%, Mdis>50% depart | 534.4 | 0.02 | 532.3 |
| 6 | Shelf>15% depart, Mdis>15% depart | 535.1 | 0.01 | 533.0 |
| 15 | LD≤50%, Shelf>50% depart, Mdis>50% depart | 535.7 | 0.01 | 533.6 |
| 14 | Shelf>50% depart, Mdis>50% depart | 537.1 | <0.00 | 535.0 |
| 8 | LD≤15%, Shelf>15% depart, Mdis>15% depart | 529.2 | <0.00 | 537.1 |
| 5 | LD≤15%, Mdis>15% depart | 540.6 | <0.00 | 538.5 |
| 17 | year | 540.6 | <0.00 | 538.6 |
| 2 | Mdis>15% depart | 543.5 | <0.00 | 539.4 |
| 10 | Mdis>50% depart | 544.7 | <0.00 | 540.4 |
| 9 | LD≤50% | 544.9 | <0.00 | 542.8 |
| 12 | LD≤50%, Shelf>50% depart | 546.4 | <0.00 | 544.3 |
| 11 | Shelf>50% depart | 547.8 | <0.00 | 545.7 |
| 3 | Shelf>15% depart | 549.0 | <0.00 | 546.9 |
| 1 | LD≤15% | 550.0 | <0.00 | 547.9 |
| 4 | LD≤15%, Shelf>15% depart | 551.6 | <0.00 | 549.5 |

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## Distribution on land

Moran's I statistic indicated that polar bears were not randomly distributed when observed during aerial surveys conducted prior to ($z = 8.51$, $P < 0.0001$; Fig 1a) and after ($z = 15.08$, $P < 0.0001$; Fig 1b) the stocking of bowhead whale remains sites in 2010–2013. The percentage of polar bears located in close proximity to bowhead whale remains sites was greater following stocking ($D = 0.14$, $P = 0.001$). Prior to stocking, 64% of polar bear observations occurred within 16 km (i.e., mean daily distance traveled by SB polar bears; [45]) of a site. After stocking 78% of all bears observed were within 16 km of a site. During surveys conducted before and after bowhead whales were harvested, we observed the greatest percentage of bears near Barter Island (40%), followed by Cross Island (33%). Relatively few bears were observed in the vicinity of Point Barrow (<2%).

## Discussion

Historical (i.e., pre-2000) use of terrestrial habitat during the open-water season by SB polar bears was relatively rare and limited to short durations [45]. Recently, land-use behavior has become more prevalent, although a majority of the SB subpopulation still remains on the sea ice during summer. We detected clear trends over time of 1) an increasing percentage of polar bears coming ashore (the percentage tripled from 2000–2014), 2) earlier dates of arrival (advancing at a rate of ~ 5 days/decade), 3) later dates of departure (~7 days later/decade), and 4) longer tenure on land (increased at a rate of ~7 days/decade). Further, increased use of terrestrial habitat was related to declines in sea ice extent and changes in sea ice phenology. Since the late 1990s, the duration of the open-water season in the SB increased by an average of 32 and 36 days based on >50% and >15% sea ice concentrations over the continental shelf, respectively, while the amount of time spent on land increased by ~3 weeks. Our results are consistent with other recent work showing increased land use by polar bears from the adjacent Chukchi Sea subpopulation over roughly the same time period [38].

The relatively infrequent historical use of land by SB polar bears was likely due to the persistent availability of sea ice over the continental shelf, even during the period of minimum sea ice extent in September. Since the late 1990s, the duration of the open-water season in the SB increased by an average of 66% or 82% (depending on sea ice concentration threshold), while the September average distance from shore to pack ice increased by 120%. Since the 2000s, the length of the open-water season has increased at a rate of ≈9 days/decade, which is among the largest rates of increase for the seas of the Arctic Ocean [14]. From 2006 to 2014, the distance from shore to September pack ice has increased an additional 65%, which placed the leading edge of the ice an average of 450 km from the continental shelf. Polar bears prefer to forage from sea ice over shallow, biologically productive continental shelf waters [13]. The lengthening period of sea ice absence over the shelf during summer equates to an increasing loss of preferred foraging habitat. Evidence suggests that displaced polar bears are increasingly coming ashore in response to this loss of sea ice habitat.

Previous work in the SB [15] and elsewhere (e.g., WH; [20]) has found that the timing of arrival of bears on shore was associated with sea ice dropping below a 50% concentration. More recently, Cherry et al. [46] evaluated multiple sea ice concentration thresholds in WH and determined that dates of arrival were best correlated with the timing of 30% sea ice concentration, while departure occurred after ice concentrations reached >10%. Our findings, that the availability of sea ice concentrations >15% (but <50%) are best correlated with the timing of arrival, length of stay, and timing of departure of SB bears, is qualitatively similar to the findings of Cherry et al. [46]. It appears that in both subpopulations, polar bears delay the transition from ice to shore until ice drops below a concentration where its use as a reliable substrate is untenable. Interestingly, our finding of an inverse relationship between timing of arrival and concentration of >15% ice over the shelf suggests that bears may come ashore before widespread disappearance of low concentration ice in order to avoid long-distance swims [47]. Collectively, our findings provide important quantitative evidence of the relationship between sea ice phenology and use of terrestrial habitat by polar bears. Monitoring the timing and rate of seasonal ice disappearance may be an effective, logistically tractable way for managers and industry to prepare for the annual arrival of bears on shore.

We found a notable increase in the proportion of radiocollared bears coming ashore in summer and fall beginning in the year 2000. From 2004 to 2007, there was a pronounced decline in the survival of SB polar bears, followed by two years (2008–2009) of apparent stability [26]. The declines and subsequent stability of survival and abundance occurred as use of terrestrial habitat was increasing. While there is no causal link between the patterns in polar bear vital rates and increased use of terrestrial habitat, there is precedence in other species for behavioral shifts ameliorating some of the adverse effects of rapid environmental change. For example, Charmentier et al. [48] found that individual adjustment of behavior allowed a population of great tits (*Parus major*) to closely track changes in prey phenology and maintain the temporal match between clutch hatch date and peak availability of prey. This suggests that behavioral adjustments that closely track key phenological shifts may lessen some impacts of rapid environmental change, at least in the short term. The decision by some polar bears from the SB to exploit terrestrial habitat, rather than remain with the retreating pack ice, appears to be a behavioral response to the loss of sea ice habitat over the continental shelf. This behavior is not necessarily surprising since other subpopulations where the sea ice completely melts every summer (e.g., WH, southern Hudson Bay, Foxe Basin, and Davis Strait) display greater use of land along with flexibility in foraging behavior [49]. In the near-term, whether bears benefit from this behavioral flexibility will likely hinge on the trade-off between the availability of food resources (and net energetic benefit), and the risks associated with accessing them, such as increased exposure to human-related activities, competition with grizzly bears (*Ursus arctos*)

[50], and increased potential for disease transmission [51]. However, for polar bears to benefit over the long term, behavioral flexibility will have to result in adaptations to environmental change on a sufficiently fast time-scale to result in evolutionary rescue [52].

Distribution data obtained from aerial surveys suggests that bowhead whale bone piles are focal attractors for bears on shore. Rogers et al. [53] found evidence of a shift in foraging behavior by some SB polar bears marked by fidelity to the nearshore region in winter and spring and consumption of bowhead whale tissue during summer and fall. It is likely that most bowhead whale tissue is consumed by bears visiting sites that have been stocked with remains following fall whaling [54], though scavenging on beach-cast whales also occurs. Nevertheless, the difference in the biomass of marine mammal food resources available to bears on shore is an important distinction between the SB and the previously mentioned five subpopulations of polar bears that have historically used land in summer. For the latter, entire subpopulations come ashore when the annual ice melts completely each summer and bears enter a hypophagic state until the ice reforms in the fall [1, 55, 56]. In WH, the open water season lasts upwards of 4 months (e.g., [57]) and model-based estimates, that assume polar bears fast while on shore, suggest that an increase beyond 5 months could trigger substantial declines in reproductive potential and survival ([58, 59, 60] but see [61]). Currently in the SB, bears are spending upwards of 2.5 months on shore and usually have access to bowhead whale remains for the latter portion of that period. If the trends of increasing use of terrestrial habitat and lengthening open water season continue in the SB, then any relative benefits of scavenging bowhead whale remains should diminish over time (assuming biomass available to bears remains consistent).

Increased use of terrestrial habitat and exploitation of human-provisioned resources by polar bears has attendant risks, including a greater potential for human-polar bear interaction and conflict. Wildlife-human conflict can have wide-ranging effects, including adversely impacting wildlife populations, causing economic losses to stakeholders, and endangering public safety [62]. The north coast of Alaska includes several villages and an industrial footprint associated with oil exploration and extraction activities, all of which are in relatively close proximity to bowhead whale remains sites (particularly at Barter and Cross Islands) where the majority of bears were detected during aerial surveys. Human-wildlife conflicts are often clustered in space and time (e.g., [63]) due to the availability and distribution of focal attractors. Given that the extent of summer sea ice is projected to decline through the 21$^{st}$ century [64], terrestrial habitat and human-provisioned resources are likely to become increasingly important for SB polar bears. Bears that are highly motivated to obtain food appear more willing to risk interacting with humans (e.g., [65]), and the increased frequency of bears on land, coupled with expanding human activity due to retreating sea ice, is expected to lead to greater human-polar bear interaction and conflict. Proactive management of human-polar bear interactions will be needed to reduce the future risk of conflict.

Our study suggests that SB polar bears have become more reliant on terrestrial habitat. Since the mid-2000s, the estimated proportion of the SB subpopulation coming ashore [15] has increased substantially and the behavior should no longer be considered trivial, even though the majority of the subpopulation still remains with the sea ice during the open-water season. Indeed, there is reason to hypothesize that use of terrestrial habitat may be adaptive, at least for the short-term. When summer sea ice persists in the SB, it is now relegated to the deep water of the polar basin which is less biologically productive than the continental shelf region. As a result, polar bears that remain with the ice may have fewer opportunities to encounter ringed (*Pusa hispida*) and bearded seals (*Erignathus barbatus*), which may explain reports of increased frequency of fasting, decreased kill rates [66, 67], and declining body condition [24]. By contrast, polar bears that come ashore and scavenge bowhead whales may be able to maximize

energy intake while minimizing energy expended, thereby reducing the likelihood of fasting and staving off declines in body condition.

Polar bears have evolved preferences for sea ice habitat and preying on marine mammals. In the SB, those preferences are informing two seemingly disparate strategies for coping with the loss of summer sea ice habitat: displace to shore and scavenge on predictably-available marine mammal food, or remain with the sea ice as it retracts over the polar basin and risk nutritional restriction [12]. Human-induced rapid environmental change is having profound effects on the quality and quantity of Arctic sea ice [68, 69], which will likely make it difficult for polar bears and other ice-adapted species to reliably select suitable habitats for maintaining fitness [70]. Behavioral plasticity is the initial response to dramatic environmental perturbations, followed by transmission of innovative behaviors within and across generations, eventually leading to evolution of the behavioral response over time [71] and, perhaps, evolutionary rescue [52]. However, behavioral plasticity may be an effective response by polar bears only if the rate of environmental change does not outpace transmission of behavioral innovations.

## Supporting Information

**S1 Table. Hypotheses and candidate linear regression models tested to predict the timing of arrival on shore, length of stay on shore, and timing of departure from shore by adult female polar bears, 1986–2014.**
(DOCX)

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## Author Contributions

Conceived and designed the experiments: TA EP. Performed the experiments: TA EP SM. Analyzed the data: TA KL RW DD PT. Wrote the paper: TA EP RW MM.

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# Subsistence harvests of bowhead whales (*Balaena*[1] *mysticetus*) at Kaktovik, Alaska (1973-2000)

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ABSTRACT

Kaktovik is a small community located on Barter Island in the extreme northeast of Alaska. The bowhead whale hunt is important to the community from both an economic and cultural perspective. Harvests were generally 1-2 bowheads per year in 1973-1988 and 2-4 bowheads per year in 1989-2000. The hunt normally begins on the first Monday in September and historically 83% of harvested whales have been taken in September. In recent years, typical harvest dates have been significantly earlier even though the quota and number of whales taken have increased. The core whaling area extends from 15km west to 25km east of Kaktovik, and offshore as far as 32km. Most whales have been taken within 30km of the village and the mean distance of harvest locations from Kaktovik has not changed from the 1970s to present. Whaling captains select small whales over large whales and there has been a marginally significant decrease in the average size of whales harvested from the 1970s to the present. The size of whales harvested does not increase with date, although other data show that smaller whales become less common in the area as the season progresses. Male and female bowhead whales are harvested in very similar numbers, but females make up 67% of whales harvested early in the season and 32% late in the season.

KEYWORDS: WHALING–ABORIGINAL; BOWHEAD WHALE; ARCTIC; BEAUFORT SEA; MIGRATION; NORTHERN HEMISPHERE; SEX RATIO; NORTH AMERICA

## INTRODUCTION

Kaktovik, also referred to as Barter Island, is a small community located on Barter Island in the extreme northeast of Alaska, within the boundaries of the Arctic National Wildlife Refuge (ANWR) (Fig. 1). The 2000 US Census enumerated 293 people, most of whom (247, or 84%) are native. Household economies rely upon both wage labour (and other income sources) and subsistence activities as vital components of an integrated system. Subsistence whaling is of high importance to the Kaktovikmiut, the 'people of Kaktovik', from both economic and cultural perspectives (Kaktovikmiut and Francis, n.d.). Subsistence activities in Kaktovik make use of a unique set of resources. Due to Kaktovik's location, hunters have access to terrestrial, riparian and marine resources, and make substantial use of all three. Jacobson and Wentworth (1982) summarised literature indicating that a prehistoric village existed at Kaktovik where 'many whale bones could be found'. Thus, the prehistoric people of the area, the 'Qanmaliurat', were certainly whale hunters, which suggests that bowhead whale (*Balaena mysticetus*) migratory patterns in the area have been similar for centuries. Of the marine mammals, the bowhead whale is the primary subsistence resource, but seals and polar bears are also taken (Jacobsen and Wentworth, 1982; Impact Assessment Inc, 1990). Subsistence activities, and especially activities surrounding the bowhead whale hunt, are central to the structural organisation and cultural identity of Kaktovik residents.

People from Kaktovik hunt whales only in the autumn, as the spring migration of bowheads past Kaktovik occurs far offshore, beyond the landfast ice zone. At Kaktovik, whaling is done from powerboats. These boats vary in characteristics, from an 18ft open Lund skiff to a 24 or 25ft cabin-cruiser type vessel. As speed is a much desired characteristic, motor size has tended to increase through time. Depending on the year, there are up to 11 whaling crews in Kaktovik. With a minimum of four or five people to a crew, most adult men are involved with whaling. Most other people in the village are involved in some support or processing capability. Whaling is an important community-wide activity.

Information from bowhead whales captured during subsistence harvests has been investigated as input to population models but it was concluded that the availability of whales to the hunters was not uniform (Punt *et al.*, 2003). If harvested whales are not a random sample of the population as a whole, then allowance must be made for the biases. Hunters from villages in northern Alaska prefer small whales to larger whales because they are easier to handle and the meat and blubber is said to be softer and better tasting (Braham *et al.*, 1980; McCartney, 1995). Thus, harvested whales do not represent a random sample of the population. This paper describes the bowhead whale harvest at Kaktovik and examines the size, sex, timing information and locations of bowhead whales harvested to assess whether they are a random sample of the population, and if not, to describe the biases.

## METHODS

The data on the bowhead whale harvest at Kaktovik have been collected by the North Slope Borough (NSB) Department of Wildlife Management (Suydam *et al.*, 1995), Alaska Department of Fish and Game (ADF&G) (Lowry *et al.*, 2004), and the National Marine Fisheries Service (NMFS) (Marquette, 1977; Braham, 1987; Withrow *et al.*, 1992). The data are archived in a database maintained by the North Slope Borough. Postmortem examinations at Kaktovik are sometimes conducted by biologists, unlike many of the other villages along the Alaskan coast. The postmortem examinations include data on sex, body length,

[1] Spelling corrected from the published version.

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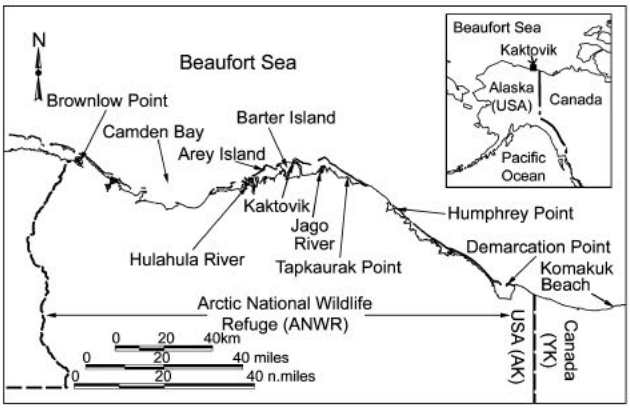


Fig. 1. Kaktovik and vicinity. Place names are according to USGS Geographic Names Information System (*http //geonames.usgs.gov*).

harvest date, a series of morphometric measurements, prey items in the stomach, reproductive status and scarring. Numerous tissue samples are also collected.

The size distribution of whales near Kaktovik was obtained by taking calibrated vertical aerial photographs of bowhead whales during studies based at Kaktovik during 1985-1986 and 1998-2000. Details of the photography methods are found in Koski *et al.* (1993) and Koski and Miller (2002).

## RESULTS AND DISCUSSION

### Numbers taken by year

Recent bowhead whale harvests at Kaktovik commenced in 1964, when two whales were harvested. NMFS records of harvests in 1964-72 are incomplete, and do not list any whales harvested at Kaktovik in 1965-72 (Marquette, 1977). However, a map in Oil/Whalers Working Group (1986) indicates that single whales were harvested there in 1968 and 1969. It is unlikely that many additional whales were harvested during this period because Kaktovik residents would remember an event as rare as a bowhead whale harvest during that period.

There was no quota on the number of bowhead whales that could be harvested before 1978, but rapid increases in bowhead harvest levels in Alaska during the mid-1970s caused concern that harvest levels were not sustainable. The International Whaling Commission (IWC) decided to impose quotas on the number of bowhead whales that could be taken by Alaskan native hunters, starting in 1978. The IWC quota is administered and monitored by the Alaska Eskimo Whaling Commission (AEWC). From 1978-1991, no more than two bowhead whale strikes or kills were allocated per year to Kaktovik. From 1992-2001, Kaktovik has been allocated three strikes or kills per year. In most years when Kaktovik reached its quota, the Kaktovik Whaling Captains Association (KWCA) could have applied for additional strikes because some strikes were not used by spring whaling villages. The most recent year when a 4th strike was transferred to Kaktovik was 2001 (and before that, 1997). During 1998-2000, additional strikes were available, but the KWCA decided not to request additional strikes because village requirements were met by the three whales landed in each of those years.

Since 1973, data on bowhead harvests have been collected by NMFS, ADF&G and the NSB, including information on numbers of whales landed, dates when whales were landed, and the sizes and sex of those whales. Fig. 2 summarises harvests at Kaktovik from 1973-2000. From 1973-1988, one or two whales were generally harvested, reflecting the village quota. In 1979 and 1981, whaling crews from Nuiqsut joined the Kaktovik whalers and the higher catches of five and three, respectively, in those years reflect the quotas from both villages. From 1989-2000, generally 2-4 whales were harvested per year.

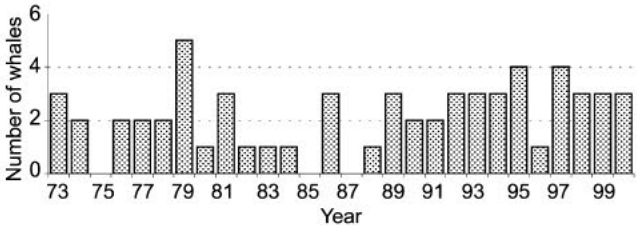


Fig. 2. Numbers of bowhead whales landed at Kaktovik each year (1973-2000). Main sources: Marquette (1977); Braham (1987); Withrow *et al.* (1992); Lowry *et al.* (2004); J.C. George (unpublished data).

### Timing of the harvest

Each year, the KWCA decides at a meeting shortly before the start of the whaling season, the date at which the hunt will begin (weather permitting). In recent years, the bowhead whale hunt at Kaktovik has normally begun on or after the first weekend in September. The scheduled start dates for the 1997-2001 hunts were 3, 4, 11, 2 and 2 September respectively. The start date of the 1999 hunt was delayed by a local emergency – a fatal boating accident. However, the hunt has started earlier in some years (e.g. by 22 August in 1992). In most years, relatively few bowhead whales are present near Kaktovik until the beginning of the westward migration of whales from summering areas east of Kaktovik (see Miller *et al.*, 2002). In addition, in recent years the KWCA has voted to delay the hunt until September, when temperatures are cooler and so the whale meat is less likely to deteriorate. Thus, the start of the hunt is usually timed to coincide with the early part of the main westward migration in early September. The whales accessible then tend to consist primarily of the small sub-adult whales that are preferred by hunters (Koski and Miller, 2002).

The dates when whales landed at Kaktovik during 1976-2000 were struck are shown in Fig. 3, organised by year (panel A) and 10-day period (panel B). The date is unknown for one of the 61 whales landed during these years. The majority (83%) of the whales landed during this period were struck during September. Thirty-two percent of the whales were struck in each of the 1-10 and 11-20 September periods, 20% were struck 21-30 September, 10% were struck 1-10 October and 3% were struck in each of 22-31 August and 11-20 October (Fig. 3B).

In recent years, the typical harvest dates have become earlier although the quota and the number of whales taken have increased. The trend for an earlier harvest is significant ($r$ = –0.46, df = 58, $p$<0.001). Based on personal observations, this change is at least partially due to an increase in the efficiency of the Kaktovik hunters in harvesting whales due to improvements in hunting techniques and equipment (boats, global positioning system (GPS), etc.). Another contributing factor may be the increase in the bowhead whale population (e.g. George *et al.*, 2004b). As a result, whales presumably are now more numerous near Kaktovik early in the hunting season than they were during the 1970s and 1980s. Changes in whale

utilisation of the general Kaktovik area (see Miller *et al.*, 2002) may also be involved. Average sighting rates during aerial surveys increased markedly in the 1990s relative to the 1980s (Miller *et al.*, 2002).

### Harvest locations

Since 1973, all bowhead whales harvested by residents of Kaktovik for which the harvest locations have been reported were struck within 43km of the village. Most of these whales were struck within 30km (Fig. 4). The core area where whalers search for whales is from Hulahula River in the west to Tapkaurak Point in the east and offshore as far as 32km (Fig. 1). Although a few of the most distant harvest locations were during the 1970s (Fig. 4), the mean distance of reported harvest locations from Kaktovik was not significantly different between the 1970s (17.0km, $n$=16), 1980s (17.9km, $n$=14) and 1990-2000 (15.2km, $n$=21) (Kruskal-Wallis test, $p$>0.05). It should be noted that the locations where 10 bowheads were struck are not known, and some reported locations, especially for years before GPS units were widely used, are approximate.

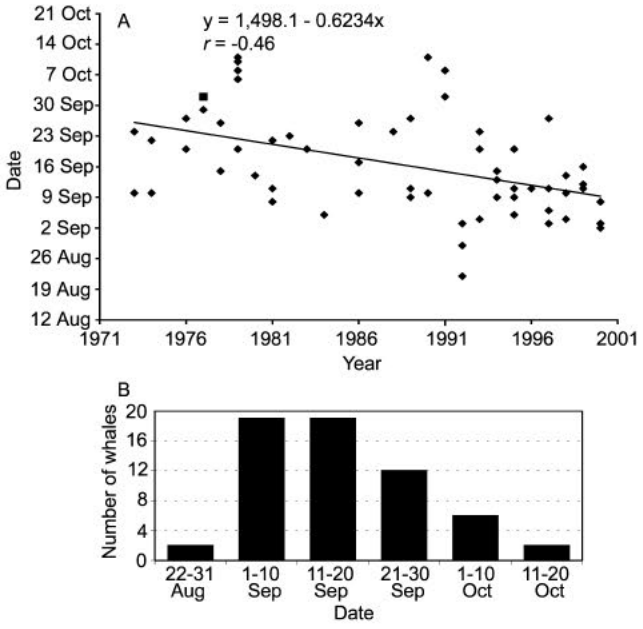


Fig. 3. Strike dates for bowhead whales landed at Kaktovik (A) by year and (B) by 10-day period, 1973-2000. The square symbol near the upper left side of panel A represents a young-of-the-year calf (approx. 5 months old). Main sources same as Fig. 2.

### Sizes of harvested bowhead whales

As noted earlier, the Kaktovik whalers attempt to harvest small whales because they are easier to handle and are considered to taste better. Thus, although the lengths of the harvested whales partly reflect the length distribution of the whales near Kaktovik at the dates in question, they are strongly influenced by hunter selectivity. The frequency distribution for the lengths of whales landed at Kaktovik is shown in Fig. 5. The reported lengths of harvested whales in Fig. 5 and subsequent figures have been reduced by 8.2% to account for the stretching that occurs when the whale is dragged onto land (see George *et al.*, 2004a). The overall range of the whales landed at Kaktovik is similar to that of the living whales whose lengths have been measured in the Arey Island to Humphrey Point area during September (Fig. 5B vs 5A).

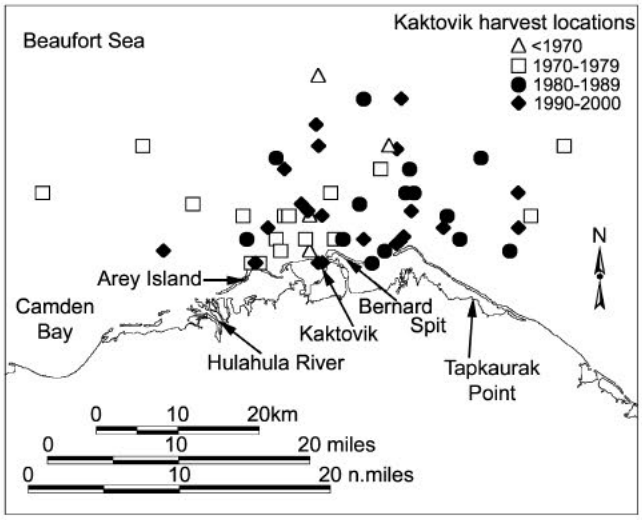


Fig. 4. Locations where bowhead whales were reported to have been harvested by residents of Kaktovik (1976-2000). Not shown are two whales taken ~170km west of Kaktovik in 1937 and 1940. Major Sources: Oil/Whalers Working Group (1986), Kaleak (1996), Lowry *et al.* (2004), J.C. George (unpublished data).

However, small whales constitute a higher percentage of the landed whales than of the whales photographed in the area. Of the bowhead whales harvested by Kaktovik whalers, 23.6% were longer than 13m (after allowance for stretching), and therefore were considered to be adults (Koski *et al.*, 1993). This compares to 43.4% adults in the overall bowhead whale population, if calves are excluded (Angliss *et al.*, 1995), and 50% adults among whales photographed near Kaktovik, calves excluded (Koski and Miller, 2002). The proportion of adults was significantly lower among the harvested whales than among the population as a whole during 1973-2000, regardless of which abundance estimate was used in the analysis, ($\chi^2$ test, $p$ <0.01) and among the whales that were photographed near Kaktovik ($\chi^2$ test, $p$ <0.001). These data confirm that the whales landed by Kaktovik whalers tend to be smaller than those in the population as a whole.

The autumn migration is partially segregated according to size, with the smaller whales tending to occur earlier in the autumn (Braham *et al.*, 1984; Moore and Reeves, 1993; Koski and Miller, 2002). However, there was no significant correlation between date and the size of a whale harvested ($r$ = –0.064, df=53, $p$ >0.05; Fig. 6). This indicates that whalers were able to select small whales throughout the whaling season even though the small whales become proportionally scarcer as the season progresses.

Fig. 7 shows the lengths of the harvested whales by the year harvested. There has been a marginally significant decline in the average size of whales harvested over the 1976-2000 period ($r$ = –0.33, df=53, $p$ <0.05). This suggests that the whalers have become more selective about the sizes of whales that they have harvested in recent years. This increased selectivity has probably been possible through some combination of two factors: increased availability of whales associated with the bowhead whale population increase, and increased efficiency of the hunters in capturing whales (allowing them to be selective while still filling their quota).

### Sex of harvested bowheads

The sex of a whale cannot generally be determined by whalers before they strike it unless it is a female accompanied by a calf, which hunters avoid taking. The sex

of 55 bowhead whales harvested at Kaktovik has been recorded. Twenty-eight were males and 27 were females, which is not significantly different than 1:1 ($\chi^2$ test, $p$ >0.05). However, during the first half of the harvest (22 August-13 September), 67% of the harvested whales were female, and during the last half of the harvest (14 September-11 October) only 32% were female (Figs 6 and 8). This difference is significant ($\chi^2$ test, $p$<0.05). From 1990 to the present, females have been more common among the harvested whales (18 females and 13 males), but before 1990 more males than females were harvested (15 males and 8 females). This difference was not significant ($\chi^2$ test, $p$>0.05) and is due to the tendency for earlier harvests in recent years, and the preponderance of females early in the season (Figs 6 and 7). The reason for segregation by sex near Kaktovik is not known.

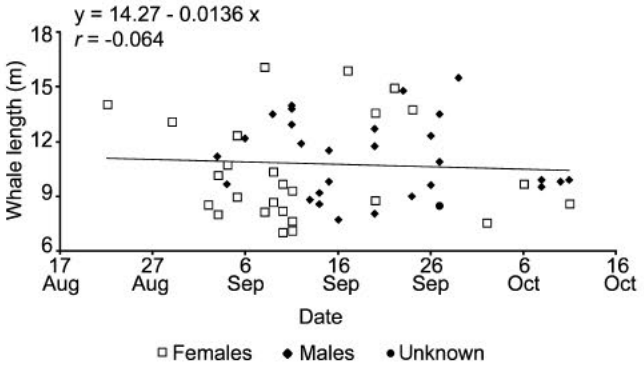


Fig. 6. Whale length vs date for whales harvested at Kaktovik (1976-2000); females and males are distinguished. A 6.2m calf harvested on 2 October 1977 is excluded. Whale lengths are adjusted downward to allow for stretching (see text).

## Conclusions

The subsistence harvest at Kaktovik during recent years is not a random sample of the bowhead population. The autumn migration of bowhead whales past Kaktovik is segregated by age and sex. The harvest, especially in recent years, has been primarily during the early part of the migration. Hunters have purposely and successfully selected small whales from among those present near Kaktovik even during periods when primarily larger whales were present. There were also sex related biases in the harvest because females appear to be more common early in the season, and males more common later in the season. Why this pattern might occur is unknown.

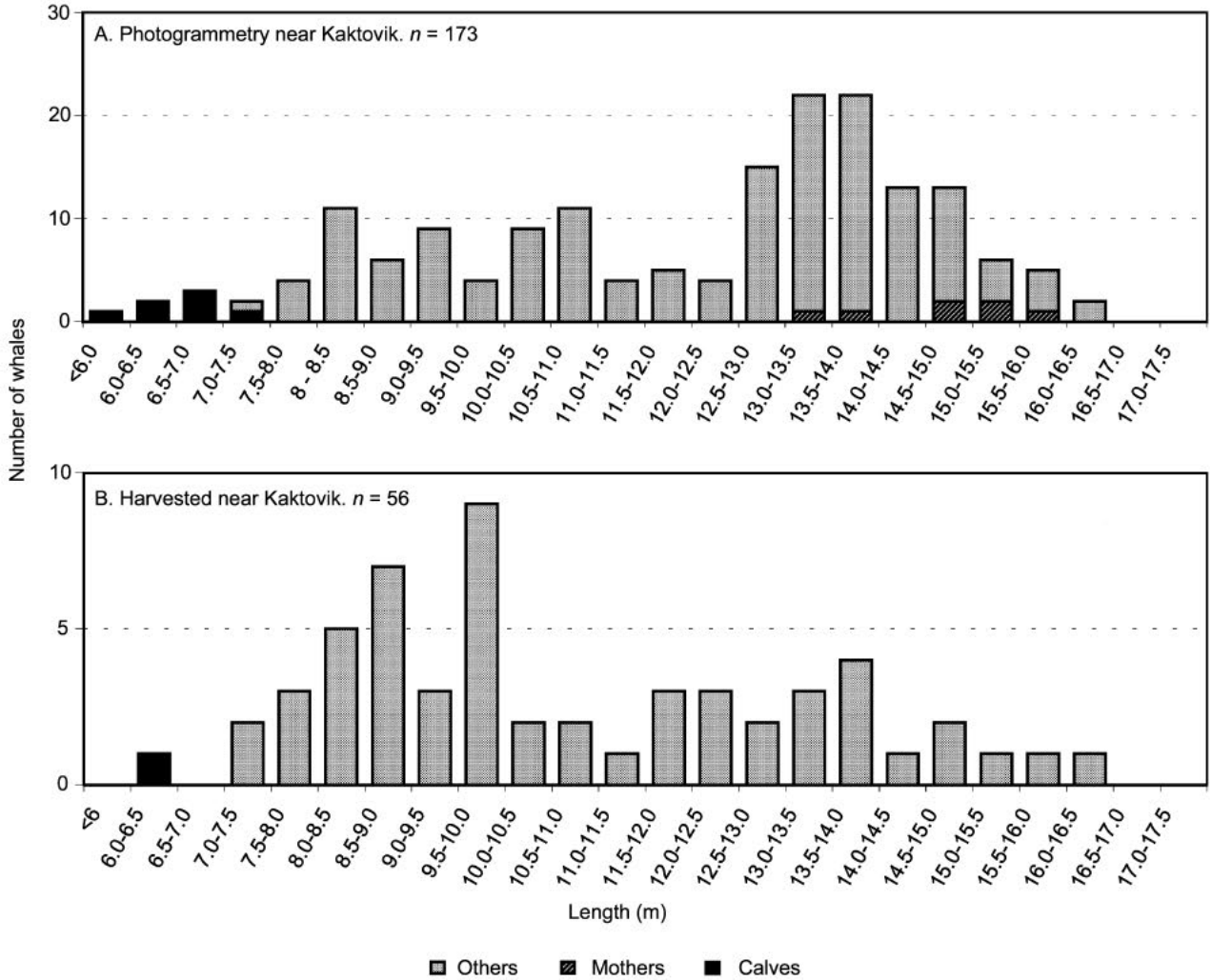


Fig. 5. Length frequency distributions of bowheads (A) photographed near Kaktovik 1982-2000 (from Koski and Miller, 2002) and (B) harvested near Kaktovik 1976-2000 (same sources as Fig. 2). In (B), lengths have been adjusted downward by 8.2% to account for stretching (see text and George *et al.*, 2004a).

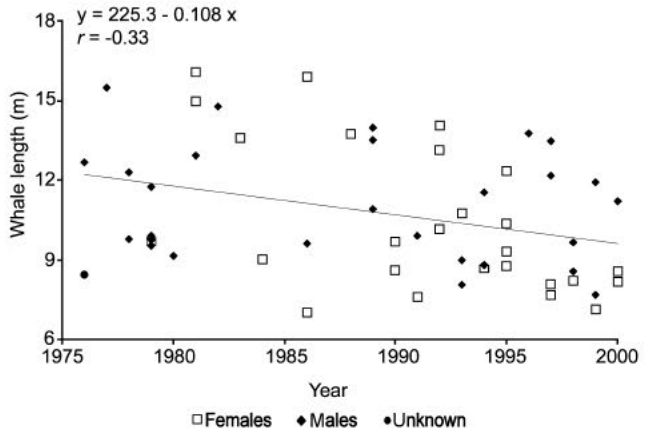


Fig. 7. Whale length vs year for whales harvested at Kaktovik (1976-2000); females and males are distinguished. A 6.2m calf harvested in 1977 is excluded. Whale lengths are adjusted downward to allow for stretching (see text).

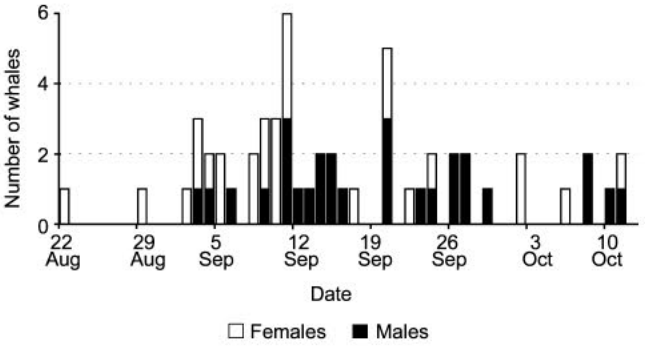


Fig. 8. Sexes of whales vs date for whales harvested at Kaktovik (1976-2000).

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ORIGINAL PAPER

# Effects of sea ice extent and food availability on spatial and temporal distribution of polar bears during the fall open-water period in the Southern Beaufort Sea

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**Abstract** We investigated the relationship between sea ice conditions, food availability, and the fall distribution of polar bears (*Ursus maritimus*) in terrestrial habitats of the Southern Beaufort Sea via weekly aerial surveys in 2000–2005. Aerial surveys were conducted weekly during September and October along the Southern Beaufort Sea coastline and barrier islands between Barrow and the Canadian border to determine polar bear density on land. The number of bears on land both within and among years increased when sea-ice was retreated furthest from the shore. However, spatial distribution also appeared to be related to the availability of subsistence-harvested bowhead whale (*Balaena mysticetus*) carcasses and the density of ringed seals (*Phoca hispida*) in offshore waters. Our results suggest that long-term reductions in sea-ice could result in an increasing proportion of the Southern Beaufort Sea polar bear population coming on land during the fall open-water period and an increase in the amount of time individual bears spend on land.

**Keywords** Polar bears · Sea ice · Distribution · Bear density

## Introduction

Identifying the ecological factors affecting animal distributions can be important for predicting population-level responses to changing environmental conditions (Mills and Gorman 1997; Musiega et al. 2006; Sutherland 2006). Such predictions are increasingly needed in the Arctic where rapid changes in pack and land-fast ice associated with climate change (Dumas et al. 2006; Holland et al. 2006; Lemke et al. 2007) are expected to result in broad ecosystem-level impacts (Gitay et al. 2002; ACIA 2005; Parmesan 2006; Serreze et al. 2007). Species living at high latitudes or altitudes are restricted to occupying the most cold-extreme habitats and as a result are some of the first to

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exhibit responses to climate change (Walther et al. 2002; Parmesan 2006). However, detecting and definitively attributing population trends in long-lived species to changing environmental conditions has been constrained by the ability to detect major declines in abundance (Taylor et al. 2007) and the potential for additional ecological processes, such as density dependence, to play a role (Ginzburg et al. 1990; Ellis and Post 2004; Derocher 2005). Identifying and understanding the mechanisms by which environmental factors, such as those attributed with climate change, may affect wildlife populations and their distribution can aid in predicting potential long-term population-level responses (Parmesan 2006).

Polar bears (*Ursus maritimus*) and their primary prey, ringed seals (*Phoca hispida*), are both highly dependent on sea ice (Stirling and Derocher 1993; Amstrup 2003; Simpkins et al. 2003), raising concerns that both species may exhibit population-level responses to changing sea ice conditions (Derocher et al. 2004; Regehr et al. 2006; Stirling and Parkinson 2006; Schliebe et al. 2006). While the life-history of some polar bear populations, such as those in Western Hudson Bay and Baffin Bay, includes spending up to 4 months of the year on land during the fall open-water period (Stirling et al. 1977; Derocher et al. 1993; Ferguson et al. 1997, 2000), polar bears in Alaskan populations, including the Southern Beaufort Sea (SBS) and Chukchi Sea, and other open basin populations (e.g., Barents Sea, Laptev Sea, Franz Joseph, Svalbard, East Greenland) typically spend most of the year on the sea ice (Garner et al. 1990; Amstrup et al. 2000; Mauritzen et al. 2001; Durner et al. 2004). However, recent reports from bowhead whale (*Balaena mysticetus*) aerial surveys suggest an increase in polar bear use of land in the fall since around 1997 (Monnett et al. 2005; Gleason et al. 2006). In addition, polar bear sightings in the vicinity of onshore oil and gas facilities (C. Perham, unpublished data) and observations by Native villagers suggest that bears have been increasing their use of land during the fall open-water period in the Alaskan SBS. Furthermore, females in this population have exhibited a shift to denning more on land and less on the sea ice in recent years (Fischbach et al. 2007). These changes have occurred over the same time period as documented reductions in the summer extent of sea ice in the SBS (Rigor and Wallace 2004; Serreze et al. 2007). Similar reductions in sea ice in Western and Southern Hudson Bay have resulted in polar bears spending more time fasting on land and as a consequence, human–bear interactions have increased (Stirling and Parkinson 2006), and bear body condition and reproduction have declined (Stirling et al. 1999; Dowsley 2006; Obbard et al. 2006; Stirling and Parkinson 2006) ultimately resulting in population declines (Regehr et al. 2008). Though declines in body condition and cub survival have also been documented in the SBS, they have not yet been directly linked to changes in sea ice conditions (Regehr et al. 2006). To better understand polar bear responses to changing ice conditions in the SBS, we investigated temporal and spatial patterns of polar bear abundance along the north coast of Alaska during the fall open-water period in relation to sea ice conditions and food availability.

Polar bears that come on land in most areas typically consume minimal, if any, food and therefore, spend the duration fasting while they await the re-formation of ice needed to access and hunt seals (Derocher et al. 1993; Atkinson and Ramsay 1995). For this reason, longer ice-free periods in Western and Southern Hudson Bay, Canada, are more clearly linked to reduction in body condition and natality (Stirling et al. 1999; Dowsley 2006; Obbard et al. 2006). Adult female polar bears fitted with GPS collars and tracked in the Southern Beaufort have only occasionally been observed coming ashore in the fall (G. Durner, personal communication), though the proportion of the total SBS population coming ashore each year in the fall is unknown. Of those polar bears that do come ashore, at least some spend time foraging on subsistence-harvested bowhead whale carcasses. Three communities, Barrow, Nuiqsut, and Kaktovik (Fig. 1), on the North Slope of Alaska consistently harvest bowhead whales each fall, and as many as 65 polar bears have been observed feeding at a single bowhead whale carcass (Miller et al. 2006). Bowhead whale carcasses have been available to polar bears at these locations since the early 1970s (Koski et al. 2005). Identifying the distribution of polar bears on the coast in relation to availability of whale carcasses is important to understanding the potential implications of increased land use on polar bear body condition and the role whale carcasses may play in affecting land use by bears. Furthermore, estimates of the minimum number of bears using land in the fall is needed to better understand potential population-level effects.

In light of the apparent changes in polar bear use of the nearshore environment and its potential to have both ecological and management implications, our objectives were to (1) determine whether within and among-year variation in polar bear abundance onshore is related to seasonal and annual variation in the extent of the pack ice and density of ringed seals over the continental shelf, and (2) identify spatial patterns of polar bear abundance onshore in relation to proximity to pack ice, availability of subsistence-harvested whale carcasses, and distribution of ringed seals in offshore areas.

As the ice retreats to its minimum extent in mid-to-late September, we predicted that the number of polar bears occurring on land would increase as opportunities for bears to return to the sea ice decline (Stirling et al. 1999; Stirling and Parkinson 2006). Though only a portion of the SBS

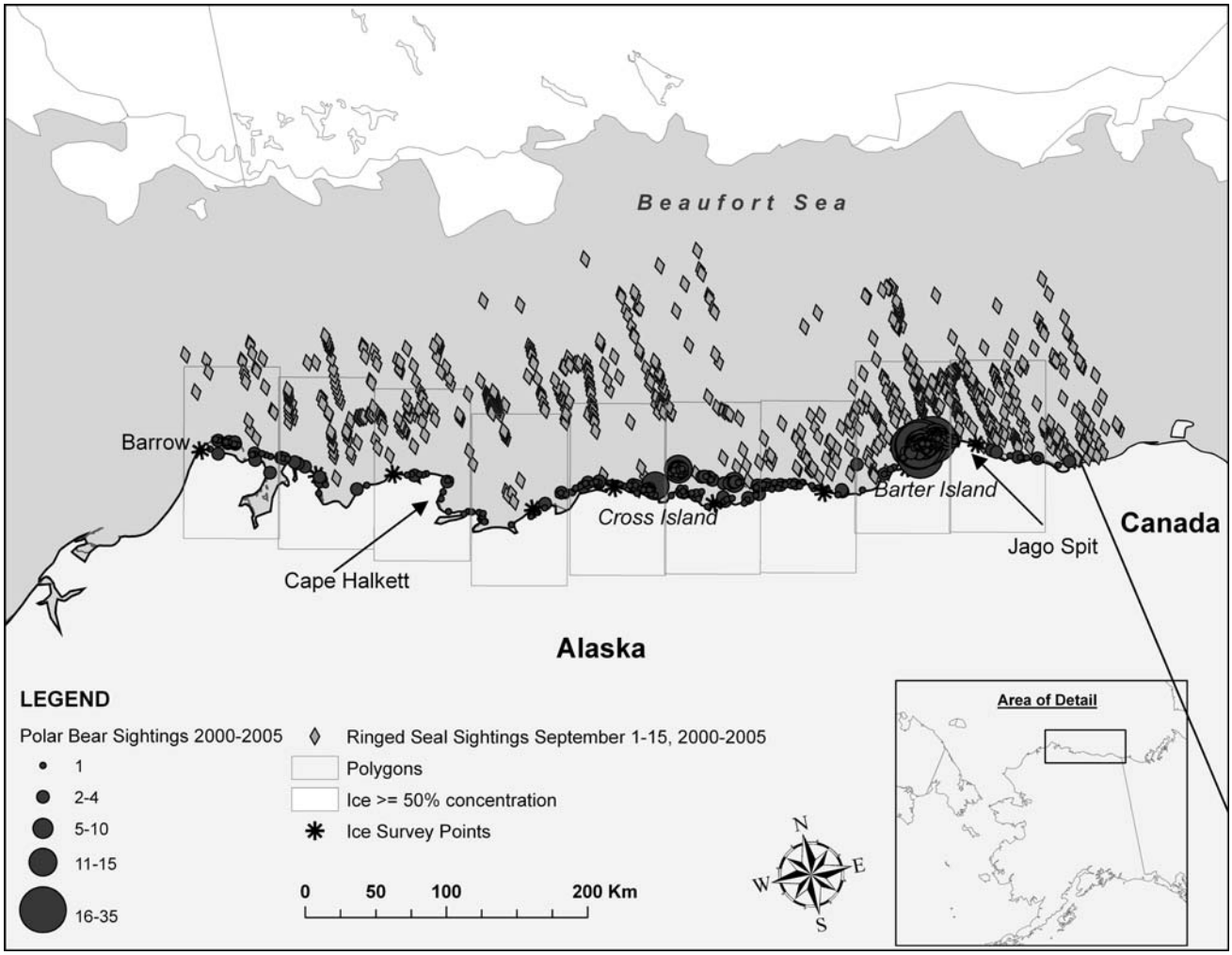


**Fig. 1** Map of polygons, ice survey points (*asterisks*), and ringed seal sightings (*diamonds*) used to quantify offshore ringed seal density, polar bear density on land, and the distance to sea-ice on the Alaskan coast of the Southern Beaufort Sea. Sea-ice shown is an example of the data provided by the National Ice Center for 3 October 2005. Note that spatial patterns were examined only between 2003 and 2005 when surveys were flown between Barrow and the Canadian border

population appears to come to shore in the fall, we hypothesized that ice conditions would affect both within and among-year variation in the total number of polar bears on shore. We further hypothesized that the largest concentrations of polar bears would occur at the three areas where subsistence-harvested bowhead whale carcasses are deposited (Miller et al. 2006), particularly since access to polar bear preferred prey, ringed seals, is believed to be limited during the open-water period. We also investigated the possibility that, despite limited access to ringed seals during the open-water period, polar bear distribution on land may be a response to annual and spatial variation in ringed seal density over the continental shelf. Though ringed seals occur primarily in open-water areas in the fall in the SBS (Harwood and Stirling 1992), several studies have suggested that locations of polar bears during the open-water period were related to future opportunities to access ringed seals (Ferguson et al. 2000; Durner et al. 2004). Thus, our analyses of spatial and temporal patterns of near-shore polar bear abundance were examined relative to ice conditions, whale carcass availability, and ringed seal distribution and relative abundance.

## Materials and methods

### Aerial survey methods

#### *Polar bear density estimates*

Indices of polar bear density were determined by conducting weekly systematic aerial surveys along the coastline and barrier islands in the southern Beaufort Sea from mid-September to late-October 2000–2005 to identify seasonal

**Table 1** Number of polar bears observed and distances surveyed for coastal aerial surveys conducted along the coast of the Alaskan Southern Beaufort Sea

| | Total No. of bears observed | Total Distance Surveyed (km) |
|---|---|---|
| 9/21/2000 | 49 | 914 |
| 9/28/2000 | 73 | 796 |
| 10/5/2000 | 72 | 856 |
| 10/12/2000 | 38 | 831 |
| 9/26/2001 | 29 | 960 |
| 10/3/2001 | 22 | 873 |
| 10/10/2001 | 30 | 842 |
| 10/17/2001 | 16 | 666 |
| 9/12/2002 | 43 | 839 |
| 9/19/2002 | 84 | 1,023 |
| 10/3/2002 | 114 | 943 |
| 10/17/2002 | 101 | 942 |
| 10/25/2002 | 41 | 806 |
| **9/17/2003** | 59 | 1,593 |
| **9/24/2003** | 61 | 1,667 |
| **10/6/2003** | 51 | 1,666 |
| **10/24/2003** | 32 | 1,452 |
| **9/15/2004** | 81 | 1,685 |
| **9/23/2004** | 106 | 1,791 |
| **10/6/2004** | 122 | 1,881 |
| **10/20/2004** | 55 | 1,650 |
| **9/12/2005** | 40 | 1,692 |
| **9/21/2005** | 82 | 1,688 |
| **10/5/2005** | 54 | 1,192 |
| **10/17/2005** | 21 | 1,488 |

Dates in bold are surveys conducted between Barrow and the Canadian border. All other surveys were conducted between Cape Halkett and Jago Spit (see Fig. 1)

changes (Table 1). During 2000–2002, the survey area extended from Cape Halkett to Jago Spit and in 2003–2005 from Barrow to the Canadian border (Fig. 1). Because polar bear activity in this area is concentrated along a relatively narrow band including the barrier islands and mainland coast, surveys were flown over these same areas each year similar to Stirling et al. (2004). Previous studies have shown perpendicular detection of polar bears from aerial surveys to remain high out to 500 m (McDonald et al. 1999; Wiig and Derocher 1999). As a result, the number of polar bears per km flown provides a "density" index for comparing temporal and spatial patterns of coastal use by bears relative to ecological conditions (Stirling et al. 2004). Since the methods were designed to generate a relative density index, we do not recommend extrapolating the values reported in this study to estimate total abundance of polar bears using the Alaskan north coast in any given year.

Surveys were flown in an Aero-Commander aircraft at an altitude of 91 m (300 ft) and a ground speed of 165–205 km/h. Two experienced observers recorded polar bear sightings. For each polar bear sighting, observers recorded sex and age of individual bears when possible. A designated observer continuously recorded changes in visibility and weather conditions. Only surveys conducted in fair to good viewing conditions were included in analyses. When necessary, animals were circled to verify counts, sex/age class, or presence/absence of cubs. However, because of our limited ability to reliably distinguish sex and age class of each bear observed, bears were further classified as either family groups or lone bears for analysis. Cubs-of-the-year could typically be distinguished from yearlings and 2-years old, but occasionally dependent young were classified as unknown age. A global positioning system (GPS; Garmin III+; Garmin International Inc., Olathe, KS, USA) recorded and time-stamped aircraft locations at 13–15 s intervals, as well as locations for all polar bear sightings. Flight tracks and polar bear sightings were entered into a Microsoft Access™ database and imported later into ESRI® ArcMap (Version 9.1; ESRI Inc., Redlands, CA, USA) to generate distribution maps.

Since distances flown varied slightly among surveys, the number of bears sighted was divided by the distance surveyed. Distances flown were determined by downloading waypoints from flights and converting point files to line files in ArcMap using Hawth's analysis tools (Version 3.06; Beyer 2004). Off-survey sections were omitted from line files and lengths of remaining lines were quantified using Hawth's tool. Distances spent circling to verify observations were not included in measures of survey distance.

*Ringed seal density*

Ringed seal density was determined from aerial surveys conducted (MMS, Anchorage, AK, USA) between 1 and 15 September 2000–2005 (Harwood and Stirling 1992). Aerial surveys consisted of randomized transect lines flown perpendicular to the coastline up to 200 km off the north coast of Alaska between Barrow and the Canadian border. Surveys were flown at an altitude of 457 m and a target groundspeed of 200–250 km/h (for further detail on survey design see Monnett and Treacy 2005). We included only data collected in Beaufort Sea states $\leq 2$ (Beaufort scale winds of 4–6 knots, wave height 1/2–1 m, and small wavelets and unbreaking waves; Chapman 1977) and during good visual conditions (Harwood and Stirling 1992). Because standard deviation of daily ringed seal estimates showed a significant negative relationship with the total transect distance covered ($R^2 = 0.90$, $F = 35.3$, $P = 0.004$), only surveys that covered >600 km distance in a single day

were included in estimates of ringed seal density. Similar to polar bear surveys, data collected on ringed seals were used as an index of spatial and temporal patterns of density and were not intended to represent population estimates.

## Data selection and analysis

### *Factors affecting polar bear density within and among years*

Analysis of both within and among year variation in polar bear density was based on counts of all bears excluding dependent young. Survey date was not included as a factor affecting polar bear density because we assumed that bears respond to ecological factors on a given date within a given year irrespective of the date itself. We hypothesized that both within and among year variation in polar bear density on land was related to the distance between land and pack ice edge. Therefore, we measured the distance to the pack ice edge using digital satellite-derived ice data in ArcMap (Version 9.1; ESRI Inc., Redlands, CA, USA). Nineteen points distributed roughly every 100 km along the coastline were created using ET Geowizards extension in ArcMap (Version 9.6; ET Spatial Techniques, Pretoria, South Africa; http://www.ian-ko.com) which selects points at equal intervals along a feature of choice specified by the user. Distances between points were calculated using measurements of the coastline and not straight line distances between points. Points located within bays or inlets were excluded so that "ice survey points" occurred only along the outer coast (Fig. 1). Ice data from the National Ice Center (http://www.natice.noaa.gov/) which includes spatial distribution and concentration of ice was used to identify areas of ice concentrations ≥50% which we defined as pack ice edge. The 50% threshold was chosen based on findings that polar bears in Western Hudson Bay and other eastern Canadian populations abandoned ice for shore when ice concentration drops below 50% (Stirling et al. 1999; Stirling and Parkinson 2006). Additionally, during autumn, radio-collared female polar bears in the SBS tend to use sea ice of 70–90% concentration (Durner et al. 2004). Distances from ice survey points to the pack ice edge of ≥50% concentration were quantified using the "Near" feature in ESRI® ArcToolbox (Version 9.1; ESRI Inc., Redlands, CA, USA) which measures the shortest linear distance between the survey point and the nearest ice of ≥50% concentration. Ice of this concentration was almost always part of the consolidated pack ice and landfast ice was excluded from measures, thus distances were essentially distances to the main pack ice, rather than randomly scattered fragments of 50% ice. Initially, we calculated mean distances across all survey points for every date in which ice data were available (typically every 3–4 days) between August and October of each year. Then, for each survey date, measures of ice conditions were calculated, including the mean and minimum distance of all ice survey points to the pack ice edge on the date of a survey. These values were then used to calculate (1) the mean distance to the pack ice edge from survey points for all dates during the month prior to the survey, and (2) the minimum distance to the ice edge for all dates during the month prior to the survey.

In addition to ice conditions affecting polar bear density on land, we investigated the role annual variation in ringed seal density over the continental shelf during the fall might play in affecting polar bear distribution in coastal areas. Ringed seal density was quantified as the number of ringed seals observed per 100 km surveyed between Barrow and the Canadian border. We also compared polar bear density on land at the minimum pack ice extent with polar bear density once land-fast ice formed. This allowed us to determine if polar bears leave land as soon as ice is available to access ringed seals offshore.

### *Spatial variation in polar bear density*

Analyses of spatial patterns of polar bear density were restricted to only 2003–2005 when polar bears were surveyed over the larger geographic scale (from Barrow to the Canadian border). Spatial patterns were determined by quantifying polar bear density in relation to ringed seal density in nine rectangular polygon layers, 60 km wide × 120 km long, created in ArcMap® (Fig. 1). To create polygons that extended a similar distance offshore, the coastline was rotated to create the best straight line coast possible. From center point of the coastline in each polygon, a 60 km offshore area was included to encompass the continental shelf area delineated by the 25 m mid-depth bathymetry line (Schumacher 1976) where coastal, shore-fast ice forms in October, and where ringed seals are likely to be first available to polar bears after the open-water period (Durner et al. 2004). Several studies have documented this area as having the highest density of ringed seals during the fall open-water period in the SBS (Harwood and Stirling 1992; Frost et al. 2004). Ringed seal densities were quantified as the total number of ringed seals observed divided by the area of water within a polygon. Polar bear density was calculated as the number of polar bears sighted per km surveyed within each polygon. The proximity of ice to a single ice survey point located within each polygon was used to quantify spatial variation in ice proximity along the coast.

## Statistical analyses

For all analyses, parametric-tests were conducted when assumptions of statistical tests could be met. Homogeneity of variance was confirmed prior to proceeding with all

analysis of variance (ANOVA) and general linear model (GLM) analyses using either a Levene's test if data were not normally distributed or an *F*-test if data were normal. Normality was tested using an Anderson–Darling test. Means and standard deviations are provided unless otherwise stated. Because ANOVAs and GLMs are robust to non-normality, these tests were used even if normality could not be achieved (Green 1979). Three-way and two-way interactive terms were included initially in all GLM analyses. However, interactive terms were removed from the GLM if $P \geq 0.10$ in a stepwise fashion, such that three-way interactive terms were first removed, the GLM was re-run, and subsequent non-significant two-way interactive terms were removed. Thus, the final model results presented exclude any non-significant interactions. All statistical analyses were conducted in Minitab® (Version 13.32; Minitab, Inc., State College, PA, USA).

*Factors affecting polar bear density within and among years*

Because the area of the coast surveyed increased in latter years which could potentially bias polar bear density estimates, a paired *t*-test was used to compare (1) truncated data sets of polar bear surveyed between Cape Halkett and Jago Spit from 2003–2005 with (2) all data collected between Barrow and the Canadian border in 2003–2005. The results of this test were used to determine if data collected in all areas could be compared across all years or if only data collected between Cape Halkett and Jago Spit could be used. A Pearson's correlation matrix was generated to identify which of the two ice measures (i.e., the minimum or mean distance to the ice edge the month prior to a survey date) was most closely related to polar bear density. A GLM was used to determine whether the distance to ice from shore varied within and among years by including Julian date as a co-variate, year as a main effect, and year × date as an interactive term. A Pearson's correlation was used to examine within year patterns of ice distance and whale carcass use by correlating Julian date with mean distance to the ice edge and the proportion of bears onshore occurring within 15 km of subsistence-harvested bowhead whale carcasses.

A linear regression was used to examine the effects of ringed seal density offshore and mean distance to pack ice on annual variation in polar bear density. Ringed seal density for this analysis was quantified as the total number of ringed seals observed per 100 km of transect offshore between Barrow and the Canadian border. To incorporate daily variation in pack ice distance across the survey period of each year, the distance to pack ice was quantified as the area under the curve (AUC) of pack ice distance (distance of ice $\geq 50\%$ concentration) versus date (Fig. 3) for the survey period each year. The AUC was then used in the regression analyses to determine if ice distance and ringed seal density were related to polar bear density among years. Subsistence-harvested whale carcasses were available to bears throughout the survey periods in all years at Cross and Barter Islands. Due to a lack of variation in whale carcass availability, it was not included as a factor affecting within or among year variation in polar bear density on land. A Friedman's repeated measures analysis was used to determine if the proportion of females with dependent young, cubs-of-the-year, and yearlings/2 year olds observed varied among years. A paired *t*-test was used to compare polar bear density between surveys conducted at the minimum extent of the pack ice in each year and surveys conducted in mid-to-late October when pack ice had extended near the continental shelf and land-fast ice had formed. We hypothesized that polar bears would move onto the sea ice from land once ice returned over the continental shelf.

*Spatial variation in polar bear density*

Analyses of the factors affecting spatial variation in polar bear density along the coast were conducted separately from analyses of the factors affecting temporal variation for two reasons. First, data was collected over the broadest geographic scale in 2003–2005 only, whereas temporal patterns were best examined across all years. Second, we hypothesized that different factors were driving temporal versus spatial variation in polar bear density. For example, the lack of year-to-year and within-year variation in bowhead whale carcass availability precluded the possibility that it was a factor driving temporal variation in polar bear density, whereas it could be an important factor affecting spatial variation. Furthermore, we were also interested in understanding the relationship between the ice edge distance and both spatial and temporal variation in polar bear density which we hypothesized might not necessarily act in the same direction (i.e., polar bear density would be higher in areas close to the ice edge but total density on land would be lower during years when the ice edge was closer to shore).

A GLM was used to determine if polar bear density differed between polygons with and without subsistence-harvested bowhead whale carcasses including distance to ice and ringed seal density offshore as co-variates. All interactions were examined, but were removed from the final model if $P > 0.10$. In addition, a Pearson correlation matrix was used to identify patterns of polar bear density, ringed seal density, and ice distance from west to east along the coast as well as relationships between polar bear density, ringed seal density, and ice distance. A regression analysis was conducted to determine if the number of polar bears observed at Barter Island accurately predicted the number of bears elsewhere on the coast in a given year.

## Results

The maximum density of bears observed during any single survey was 8.6 bears/100 km or 122 bears total. Across all years and survey dates between mid-September and the end of October, an average of $4 \pm 2$ bears/100 km ($57 \pm 28$ bears total) were observed. Thus, a maximum of 8.0% and an average of 3.7% of the estimated 1,526 bears in the SBS population (Regehr et al. 2006) were observed on land.

### Factors affecting polar bear density within and among years

Number of bears observed per km of survey flown was higher (paired $t = -6.43$, $df = 10$, $P < 0.001$) between Cape Halkett and Jago Spit ($3.87 \pm 1.59$ bears/100 km) than the area surveyed between Barrow and the Canadian border ($2.88 \pm 1.26$) during the 2003–2005 surveys (Fig. 2). As a result, data used in all temporal analyses were restricted to only those surveys conducted between Cape Halkett and Jago Spit in 2000–2005 so that relationships could be examined among all years. The distance surveyed was related (Spearman's $r = 0.40$, $n = 25$, $P = 0.05$) to the number of bears encountered per km, but this relationship was not present once we removed a short survey conducted on 17 October 2001 ($r = 0.35$, $n = 24$, $P = 0.10$). This lack of relationship suggests that effort (survey length) was sufficient to accurately estimate polar bear density and that estimates were not biased by survey length.

Mean distance from shore to pack ice along the coast varied both within (Fig. 3; $F_{1,12} = 10.87$, $df = 1$, $P = 0.006$) and among years ($F_{5,12} = 5.32$, $df = 5$, $P < 0.008$). The distance to pack ice of ≥50% concentration was negatively correlated with date ($r = -0.688$, $df = 1$, $P < 0.0001$). Mean distance to ≥50% ice concentrations during the month prior to a survey was more closely related to polar bear density ($r = 0.75$, $n = 19$, $P = 0.0002$; Fig. 4) than any other ice measure. The distance to ≥50% ice concentration on the survey date was also related to polar bear density onshore ($r = 0.627$, $n = 19$, $P = 0.005$). In all years, the number of bears observed along the coast was higher ($5.17 \pm 2.37$ bears/100 km) during the period of pack ice retreat (Fig. 2: ice distance of $208.2 \pm 102.6$ km) than after land-fast ice formed ($2.58 \pm 0.84$ bears/100 km)($t = 3.87$, $df = 5$, $P = 0.012$) and the distance to offshore ice concentrations ≥50% declined (i.e., after October 12th ice distance: $84.4 \pm 73.6$ km)($F_{1,10} = 5.76$, $P = 0.037$). For all years, the proportion of bears using whale carcasses increased throughout the survey period (mid-September to mid-October; Fig. 5). Those bears that remained ashore after land-fast ice formation and pack ice formation advanced occurred almost exclusively near whale carcasses, whereas earlier in the season bears were more uniformly distributed along the coastline.

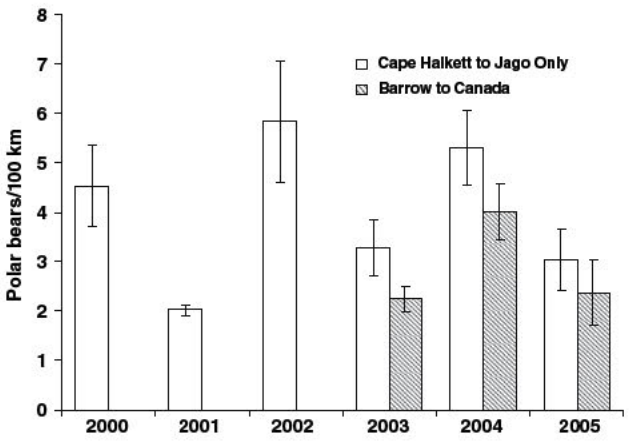


**Fig. 2** Annual variation in the number of adult and subadult polar bears observed per 100 km during aerial surveys flown from Cape Halkett to Jago Spit only between 2000 and 2005 and flown from Barrow to the Canadian border between 2003 and 2005

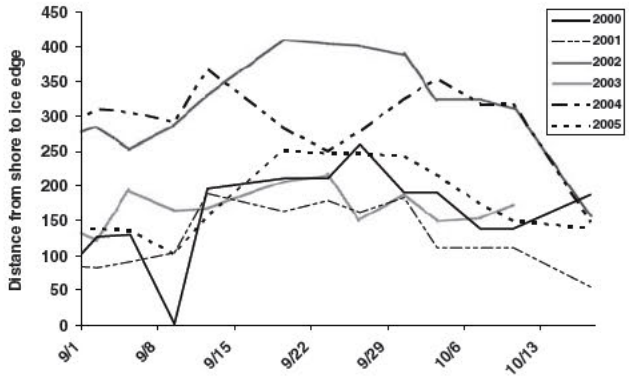


**Fig. 3** Seasonal variation in the mean distance from survey points along the north coast of Alaska between Barrow and the Canadian border to the edge of ≥50% ice concentration

Annual variation in the density of adult and subadult bears onshore was directly related to the distance to pack ice. Annual variation in polar bear density during mid-September surveys was related to ringed seal density offshore during the 2 weeks prior to surveys (Fig. 6a). In addition, variation in the mean polar bear density across all surveys was related to the area under the curve for Fig. 3 (mean distance to 50% ice concentration between 1 September and 10 October; Fig. 6b). A step-wise regression that included both factors suggests that ice conditions, quantified as AUC, had the greatest effect on annual variation in polar bear density ($t = 3.32$, $P = 0.029$). Annual variation in ringed seal density was not correlated with distance to ice ($r = 0.609$, $P = 0.199$). There was no apparent trend in polar bear density with year ($r = -0.009$, $df = 1$, $P = 0.99$).

There was no difference among years in the proportion of females with dependent young ($29.5 \pm 8.9\%$) (Friedman's repeated measures: $F = 0.88$, $df = 5$, $P = 0.52$) or the

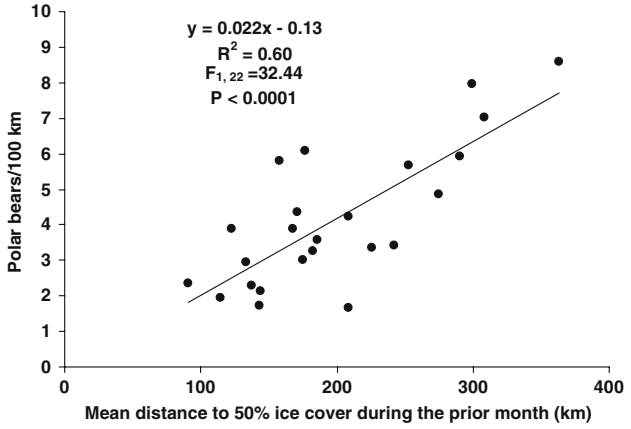


**Fig. 4** The relationship between the polar bear density on the Alaskan coast of the southern Beaufort Sea and mean distance to the ice edge during the month prior to each survey date

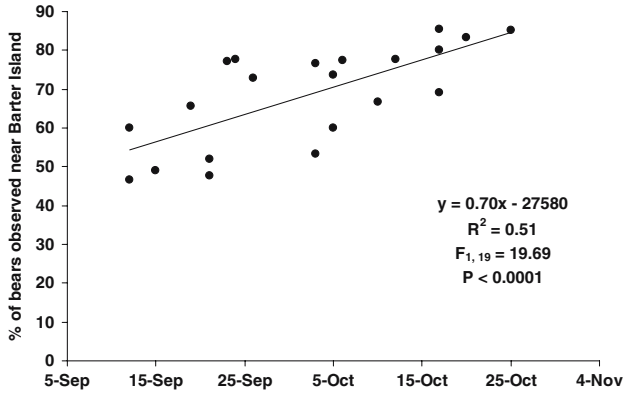


**Fig. 5** Relationship between survey date and the percent of all adults and subadults observed on the survey that occurred within 15 km of subsistence-harvested bowhead whale carcasses at Barter Island, Alaska. Surveys were conducted weekly from 2000 to 2005. Dates in which greater than 50% of bears observed were recorded as unknowns were excluded

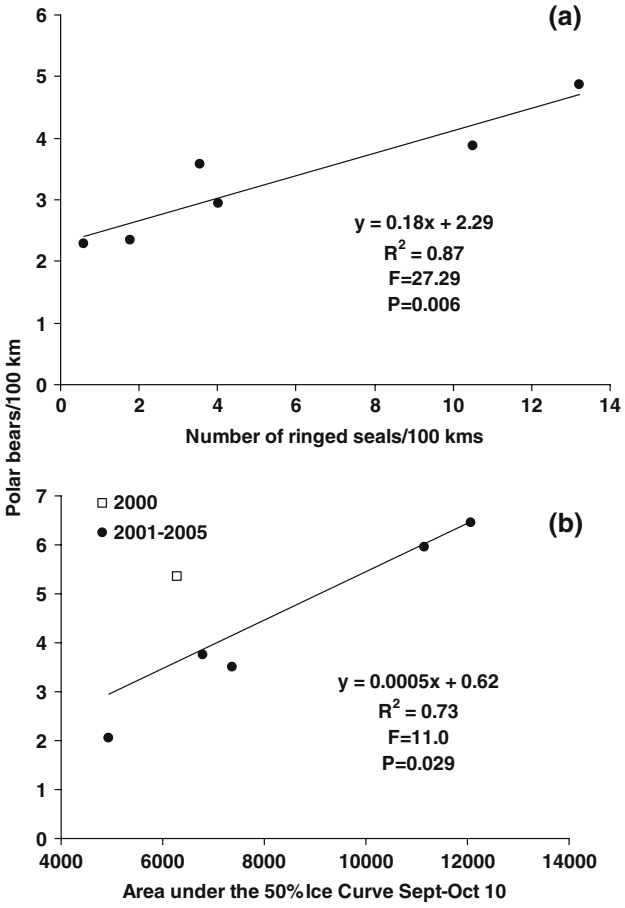


**Fig. 6** Relationships between polar bear density onshore, ringed seal density offshore (**a**), and the area under the curve of mean distance to sea-ice of ≥50% concentration for each year surveyed (**b**). Ringed seal density was determined for 1–15 September over the continental shelf of the Alaskan Beaufort Sea and related to polar bear density onshore during the first survey of each year ranging between 12 and 26 September. The Area under the Curve was determined for September through October and related to the mean number of polar bears observed per km across all surveys for a year. Polar bear density is for Cape Halkett to Jago Spit only (see Fig. 1)

percent of dependent young ($30 \pm 6\%$ of all bears observed)($F = 0.63$, $df = 5$, $P = 0.68$) observed in coastal surveys. Of the dependent young observed, the proportion of cubs-of-the-year (COY) and yearlings/2 years old were consistent across years (COY: $56.4 \pm 19\%$ of all dependent young; $F = 0.60$, $df = 5$, $P = 0.70$; yearlings: $41.6 \pm 18.4\%$; $F = 0.94$, $df = 5$, $P = 0.49$).

## Spatial variation in polar bear density

Polar bear density was higher ($7.1 \pm 8.1$ bears/100 km) in polygons where subsistence-harvested whale carcasses were present compared to polygons where carcasses were absent ($1.2 \pm 1.2$ bears/100 km) ($F_{1,23} = 6.25$, $P = 0.02$), but there was an interactive effect between ringed seal density over the continental shelf and whale carcass availability ($F_{1,23} = 8.5$, $P = 0.008$). Thus, the confounding effects of high ringed seal density ($F_{1,23} = 18.59$, $P < 0.0001$) and whale carcass availability could not be separated. Distance to pack ice was not a significant co-variate affecting polar bear density across polygons ($F_{1,21} = 0.97$, $P = 0.34$) and was excluded from the general linear model. Polar bear density was also related to ringed seal density across polygons ($r = 0.75$, $P < 0.0001$), but not to the distance to ice edge ($r = -0.12$, $P = 0.57$).

Ringed seal density within 60 km of the mainland coast increased ($r = 0.41$, $P = 0.032$) and distance to ice edge decreased($r = -0.41$, $P = 0.033$) from west to east along the coast. Ringed seal density was not correlated with the distance to ice edge ($r = -0.14$, $P = 0.49$). For the three communities that harvest bowhead whales, the density of polar bears in a polygon was not correlated with the number

of whales harvested ($r = -0.5$, $P = 0.5$). Conversely, 80.5 ± 15.7% of all polar bears observed during aerial surveys occurred ≤15 km of whale carcasses; 68.9 ± 14.2% of polar bears observed on the coast occurred at Barter Island alone. The number of bears concentrated at Barter Island in a given year was not representative of trends in bear density along the rest of the coast as a whole ($R^2 = 0.10$, $F_{1,19} = 3.13$, $P = 0.09$).

## Discussion

Polar bear density along the mainland coast and on barrier islands during the fall open-water period in the SBS was related to the distance between shore and the pack ice edge and the density of ringed seals over the continental shelf. The distance between pack ice edge and the mainland coast, as well as the length of time in which these distances prevailed as quantified by the AUC, was directly related to polar bear density onshore. In addition to ice proximity, we hypothesize that the distribution of ringed seals may be affecting polar bear density onshore throughout the fall open-water period by (1) encouraging bear movement on to land so they have access to seals that concentrate in open-water over the continental shelf when the pack ice retreats and, or (2) influencing bear distribution as they utilize areas of high ringed seal density to maximize future hunting opportunities in the fall once land-fast ice forms. The relationship between ringed seal density over the continental shelf in mid-September and concurrent bear density onshore suggests that the former hypothesis may be correct, while the relatively dramatic decline in polar bear density onshore in mid-October once land-fast ice forms supports the latter hypothesis. Thus, both ice conditions and ringed seal density may affect bear density on shore during the fall open-water period. If the extent of summer pack-ice continues to decline as predicted by many climate models (Zhang and Walsh 2006; Serreze et al. 2007; Stroeve et al. 2007), polar bears may be more likely to come ashore during this time to gain access to ringed seals over the continental shelf on recently frozen land-fast ice in the fall, rather than remain on the pack-ice where they may wait a longer period for ice to extend over the shelf.

Spatial patterns of polar bear density onshore appeared to be influenced by the presence or absence of subsistence-harvested bowhead whale carcasses. Polar bear density was over six times higher in areas where whale carcasses were available. However, this difference was largely driven by a major concentration of bears (69% of total bears onshore) at Barter Island (17.0 ± 6.0 polar bears/100 km). The two other native communities harvesting bowhead whales had much lower polar bear density (Barrow: 2.2 ± 1.8; Cross Island: 2.0 ± 1.8) despite both of these communities consistently harvesting higher numbers of bowhead whales (12.2 ± 4.9 and 4.2 ± 12 whales/year at Barrow and Cross Island, respectively) compared to the Kaktovik community on Barter Island (3.2 ± 0.4 whales/year; Suydam et al. 2000, 2001, 2002, 2003, 2004, 2005). Bowhead whales are typically harvested earlier on Barter and Cross Islands (mean date of harvests 7 and 8 September, respectively for 2000–2005) than at Barrow (mean date of harvest 7 October; Suydam et al. 2000, 2001, 2002, 2003, 2004, 2005) providing earlier foraging opportunities to land-based polar bears. However, the location of bears onshore coincides with areas where the distance to ice edge is shortest. The shorter distance to the pack ice edge and higher ringed seal density documented along the eastern edge of the study area where polar bear density was also highest is supported by other studies (Frost et al. 2004; Fischbach et al. 2007). Thus, bears at Barter Island not only avoid fasting by foraging on whale carcasses during the open-water period, they also maximize future hunting opportunities and earlier access to high densities of ringed seals once land-fast ice forms.

Overall, we did not detect an increasing trend in polar bear densities along the Beaufort Sea coast of Alaska during the six years of this study. Conversely, an increase in the proportion of female polar bears denning on land in the SBS (Amstrup 2000; Fischbach et al. 2007) and an apparent increase in the proportion of polar bears sighted on land compared to sea ice during the fall (Gleason et al. 2006) have been documented previously over a period of decades. Thus, either changes are occurring over longer time scales than we examined, or the trend has changed such that the density of polar bears on the coast is either undetectable or stable. Our study does, however, suggest that predicted reductions in the extent of summer sea ice (Hansen et al. 2005; Holland et al. 2006; Serreze et al. 2007), as well as potential for delayed formation of land-fast ice in the fall (Dumas et al. 2006) would likely result in an increase in the number of polar bears using land. Furthermore, in this study, bear density onshore declined only once the mean distance to ice concentrations ≥50% along the shore reached a distance of ≤100 km, suggesting the duration of time bears spend onshore could also increase. There was a strong relationship between annual variation in the number of bears onshore and the mean distance to pack ice edge during the fall open-water period. Duration of sea ice is predicted to decrease by 10 days by 2020 and 15–20 days by 2050 with additional thinning of land-fast ice (ACIA 2005; Dumas et al. 2006). In addition, a number of studies have suggested that recent changes will result in more bears coming ashore for longer periods (Derocher et al. 2004; Stirling and Parkinson 2006).

Factors attributed to within and among-year variation in polar bear density on land in this study were similar to

patterns documented for polar bears on Wrangel Island, and along the Chukotka coast in Russia (Kochnev 2006). In these areas, the number of bears on land was correlated with the distance to ice edge and the availability of walrus (*Odobenus rosmarus*) carcasses during the open-water period. Polar bears in these areas congregate at walrus haulout sites where they feed on stampeded walrus during the ice-free period in the western Chukchi Sea. The opportunity for bears in the Chukchi Sea and SBS to feed during the fall open-water period differs from some Canadian populations, such as Western Hudson Bay, Davis Strait, and Baffin Bay which are entirely ice-free seasonally and resulting in polar bears primarily spending the open-water period fasting (Stirling et al. 1977; Derocher et al. 1993; Ferguson et al. 1997). Thus, the nutritional effects documented in polar bears in Western and Southern Hudson Bay (Stirling et al. 1999; Obbard et al. 2006) associated with a longer period of open-water may not occur in the Southern Beaufort and Chukchi populations provided that the nutritional value of bowhead whale and walrus carcasses meet the energetic demands required to offset reduced foraging opportunities on seals. This suggests that in the SBS recently documented declines in body condition of bears (Regehr et al. 2006) are the result of mechanisms other than increased land use.

Though subsistence-harvested bowhead whale carcasses may be a significant anthropogenic food source for polar bears, polar bear concentrations at carcasses have the potential to increase bear–human interactions and exposure to oil spills (Perham 2005; Miller et al. 2006). Food-habituation of bears has been attributed with increased bear mortality (Herrero 2002). However, the number of polar bears sighted during fall aerial surveys was not related to the number of bears reported as harvested for subsistence ($r = 0.36$, $n = 6$ years, $P = 0.48$) or due to defense of life in local communities (i.e., Barrow, Nuiqsuit, and Kaktovik) across years ($r = 0.22$, $n = 6$ years, $P = 0.68$). This result occurred despite polar bear density on the coast varying by a factor of two during the study which is believed to reflect local hunter values of conserving polar bears with a harvest based on need versus availability. However, fall polar bear subsistence harvests, in general, are relatively low on the North Slope and are not necessarily indicative of whether bears are learning to associate villages with food and thereby increasingly coming to villages throughout the year when natural sources of food may be scarce. Total polar bear subsistence harvests and defense of life killings for the Alaskan side of the SBS were stable throughout the course of this study, but had increased from earlier periods (USFWS 2007). Several management mechanisms exist to maintain stable levels of polar bear subsistence harvest despite potential increases in bear–human interactions, including an oil-field hazing program managed by the US Fish and Wildlife Service (Perham 2005), a co-management agreement between the Inuvialuit Game Council and the Alaskan North Slope Borough signed in 1988 which sets annual harvest quotas for the SBS (Brower et al. 2002), and polar bear patrol programs conducted by Natives in the villages of Barrow and Kaktovik.

Removal of whale carcasses to minimize bear–human interactions both in villages and in relative proximity to oil and gas fields is complicated by the potential to increase nutritional stress similar to that exhibited by bears in Western Hudson Bay. Currently, the majority of bears coming to shore appear to be utilizing whale carcasses. In the absence of whale carcasses, bears are likely to continue their pattern of coming ashore in the fall in order to remain close to the continental shelf where ringed seal density is concentrated (Harwood and Stirling 1992; Frost et al. 2004) and where landfast ice formation provides earlier access to ringed seal habitat. The nutritional implications of reductions in fall sea-ice extent may therefore also now be influenced by accessibility to and availability of bowhead whale carcasses. A recent study found that bowhead whales constituted 6–18% on average of winter diets of polar bears in the Southern Beaufort Sea (Bentzen et al. 2007). Other potentially negative aspects of increased land use by polar bears during the fall open-water period include extended open-water swimming (Monnett and Gleason 2006), increased intra-and interspecific interactions, potential increase in disease transmission, and increasing bear–human interactions. We recommend that these issues be further evaluated and monitored.

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# Relative influences of climate change and human activity on the onshore distribution of polar bears☆

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ABSTRACT

Climate change is altering habitat for many species, leading to shifts in distributions that can increase levels of human-wildlife conflict. To develop effective strategies for minimizing human-wildlife conflict, we must understand the relative influences that climate change and other factors have on wildlife distributions. Polar bears (*Ursus maritimus*) are increasingly using land during summer and autumn due to sea ice loss, leading to higher incidents of conflict and concerns for human safety. We sought to understand the relative influence of sea ice conditions, onshore habitat characteristics, and human-provisioned food attractants on the distribution and abundance of polar bears while on shore. We also wanted to determine how mitigation measures might reduce human-polar bear conflict associated with an anthropogenic food source. We built a Bayesian hierarchical model based on 14 years of aerial survey data to estimate the weekly number and distribution of polar bears on the coast of northern Alaska in autumn. We then used the model to predict how effective two management options for handling subsistence-harvested whale remains in the community of Kaktovik, Alaska might be. The distribution of bears on shore was most strongly influenced by the presence of whale carcasses and to a lesser extent sea ice and onshore habitat conditions. The numbers of bears on shore were related to sea ice conditions. The two management strategies for handling the whale carcasses reduced the estimated number of bears near Kaktovik by > 75%. By considering multiple factors associated with the onshore distribution and abundance of polar bears we discerned what role human activities played in where bears occur and how successful efforts to manage the whale carcasses might be for reducing human-polar bear conflict.

## 1. Introduction

Climate change is significantly altering habitat for many species (Durner et al., 2009; Dirnböck et al., 2011) and has been observed to alter distributions of wildlife populations (Nye et al., 2009; Chen et al., 2011). Similarly, species are using new areas within their existing ranges to adjust to changing environmental conditions (Melin et al., 2014). These changes have the potential to lead to increased levels of human wildlife conflict (Baruch Mordo et al., 2014). For example, in Nepal, climate change related shifts in vegetation have led blue sheep (*Pseduois nayaur*) to forage at lower elevations where they consume human crops, leading to conflict (Aryal et al., 2014). Snow leopards (*Panthera uncia*) have followed blue sheep to these areas, leading to increased levels of livestock depredation (Aryal et al., 2014).

Polar bears (*Ursus maritimus*) have exhibited shifts in habitat use due to sea ice loss associated with climate change (Rode et al., 2015; Atwood et al., 2016). As sea ice has declined, the number of polar bears coming on shore and time spent there has increased for some sub populations (Rode et al., 2015; Atwood et al., 2016) and has led to higher incidences of human polar bear conflict (Dyck, 2006; Towns et al., 2009). In two studies researchers found that the majority of polar bears killed in defense of life occurred during the open water season (Stenhouse et al., 1988; Dyck, 2006). Thus, as more bears come on shore during summer, there is an increased risk of human polar bear

☆ RH: Polar bear onshore ecology

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conflict. This has the potential to result in more defense of life kills, direct concerns for human safety (Derocher et al., 2013), and disruption to industrial, recreational, and subsistence activities.

Previous research has shown that use of onshore habitat by polar bears during summer and autumn is not randomly distributed (Schliebe et al., 2008; Rode et al., 2015). For example, Rode et al. (2015) found that polar bear use of onshore areas in the Chukchi Sea was related to the date of sea ice retreat, with areas of coastline having later dates of retreat receiving greater use by bears. Further, when on shore, polar bears in the southern Beaufort Sea are disproportionately distributed along barrier islands rather than mainland coastal areas (Gleason and Rode, 2009). Polar bears can also be drawn to areas with human attractants, such as garbage dumps (Towns et al., 2009) and the remains of marine mammals harvested for subsistence (Miller et al., 2015). While numerous links have been documented relating polar bear onshore distribution to biotic and abiotic factors, it remains unclear what the relative roles each of these factors play in determining polar bear abundance and distribution.

Determining the relative influence of sea ice conditions, onshore habitat, and anthropogenic food sources and other attractants have on where bears occur on shore is important for understanding how to mitigate human polar bear conflict. For example, if polar bears are drawn to communities primarily due to the availability of food, then moving or removing the food attractant could reduce conflict. Conversely, if bears are drawn to the area primarily due to onshore habitat conditions (e.g., barrier islands) or preferable sea ice dynamics, such as earlier return of sea ice, then mitigation to remove attractants might be less effective.

Mitigating emergent conflicts with wildlife that could be caused, in part, by climate change requires an understanding of the relative influences that climate change and other factors have on the altered species' distribution (White and Ward, 2010). We therefore developed a Bayesian hierarchical model to understand the relative roles sea ice, coastal habitat, and human activity had on the weekly number and distribution of polar bears along the northern coast of Alaska. Our analysis was based on aerial survey data and systematic ground based counts collected from late August through October between 2000 and 2014. We then used the model to predict how different management strategies for a human derived food source might decrease the number of polar bears near to the coastal community of Kaktovik, Alaska (where large aggregations of polar bears can be found within and adjacent to the community), while controlling for the influences of sea ice and onshore habitat conditions.

## 2. Materials and methods

### 2.1. Study area

Our study area extended from Point Barrow, Alaska, east to the Canadian Border (Fig. 1) along the Beaufort Sea coast. The Beaufort Sea has a narrow band of continental shelf along the Alaskan coast, stretching < 100 km offshore, then quickly dropping off to some of the deepest waters in the Arctic Ocean. We divided the study area into 10 equal width (60.5 km) grids, which contained different lengths of coastline (Table A1). The study area encompasses three communities (i.e., Barrow, Nuiqsut, and Kaktovik; Fig. 1), all of which annually harvest bowhead whales (*Balaena mysticetus*) in autumn for subsistence purposes. Whaling in Barrow and Kaktovik occurs adjacent to town, and residents of Nuiqsut base their whaling efforts on Cross Island (Fig. 1). In addition to the three whaling communities, a large oil production complex is located in Deadhorse and adjacent areas, consisting of oil production facilities and supporting infrastructure (Fig. 1).

Polar bears from the Southern Beaufort Sea (SB) subpopulation are most likely to occur in the study area, but bears from the Chukchi Sea and Northern Beaufort Sea subpopulations can be present (Amstrup et al., 2004). There are currently 900 animals estimated to be in the SB subpopulation (Bromaghin et al., 2015). The proportion of bears from the SB subpopulation coming on shore each summer and the period of time spent on shore has increased in the past decade (2000 2014) from a period (1986 1999) before precipitous declines in sea ice extent occurred (Overland and Wang, 2013; Atwood et al., 2016).

### 2.2. Aerial surveys

We flew aerial surveys annually in 2000 2014, except during 2006. Surveys occurred between early August and late October, although timing and frequency varied among years (i.e., the number of surveys ranged from 2 to 5 in a given year). Only one survey occurred during any given week. We restricted our analyses to the time period between the last week of August through the last week of October, because these periods were represented in most years of the survey. The majority of surveys occurred between Barrow, Alaska and the Canadian Border (Fig. 1) along the mainland coast and barrier islands, although poor weather conditions often limited our ability to complete all sections of coastline during each survey week. From 2000 to 2002, surveys were restricted to the area between Cape Halkett and Barter Island (Fig. 1).

Four aircraft types were used for surveys during the study; a Turbo Commander plane from 2000 to 2008, an R 44 helicopter from 2009 to 2010 and 2012 2014, a Bell 206 helicopter in 2011, and an A Star helicopter for a portion of the 2013 surveys. During surveys all aircraft flew approximately 300 m offshore, at an altitude of approximately 90 m, and at a speed of 150 185 km/h. We implemented a double observer design in which a front and rear observer independently spotted groups of polar bears (Supplementary appendix B). Across all aircraft types, we estimated very high detectability (98.2%; 95% C.I.: 97.5 98.7) of polar bear groups (Supplementary appendix B), likely due to the low altitudes we flew and the stark contrast between bears and coastline substrates. Thus, to simplify modeling, we assumed that polar bears were observed 100% of the time if they occurred on the coastline. Our surveys did not include distance sampling methodology because most polar bears were concentrated on the mainland coast or barrier islands, so we considered our sampling area to be the linear coastline.

### 2.3. Ground based surveys

We supplemented aerial survey data with three datasets of daily, systematically collected, ground based counts of polar bears from Cooper Island (Fig. 1a), Cross Island (Fig. 1b), and Barter Island (where Kaktovik is located; Fig. 1c). For each location, we obtained the maximum number of bears observed during daily counts within a week for input into the model (see below, Observation model section). During most years of the study, counts on Cooper Island were restricted to the last week of August (2000 2014), with one year providing counts during the first week of September 2005. Counts on Cooper Island were conducted from a fixed point and covered a distance of approximately 4 km of coastline, nearly 50% of the island. Counts on Cross Island occurred from 2002 to 2004 during mid September through the end of the month (corresponding to the period when whaling occurs, except in 2004 when it occurred after whaling). Counts were from a fixed location on the island that allowed observers to count bears over the entire island, totaling approximately 5 km of coastline. Barter Island counts occurred during September each year in 2002 2014. Counts on Barter Island were made along a road transiting the northern end of Barter Island, and from two fixed locations that allowed observers to count polar bears along two adjacent islands, totaling approximately 12 km of coastline (Fig. 1c).

### 2.4. Analytical methods

We used a Bayesian hierarchical modeling framework to estimate onshore abundance of polar bears that was able to account for multiple levels of uncertainty in the data as well as incorporate ground based

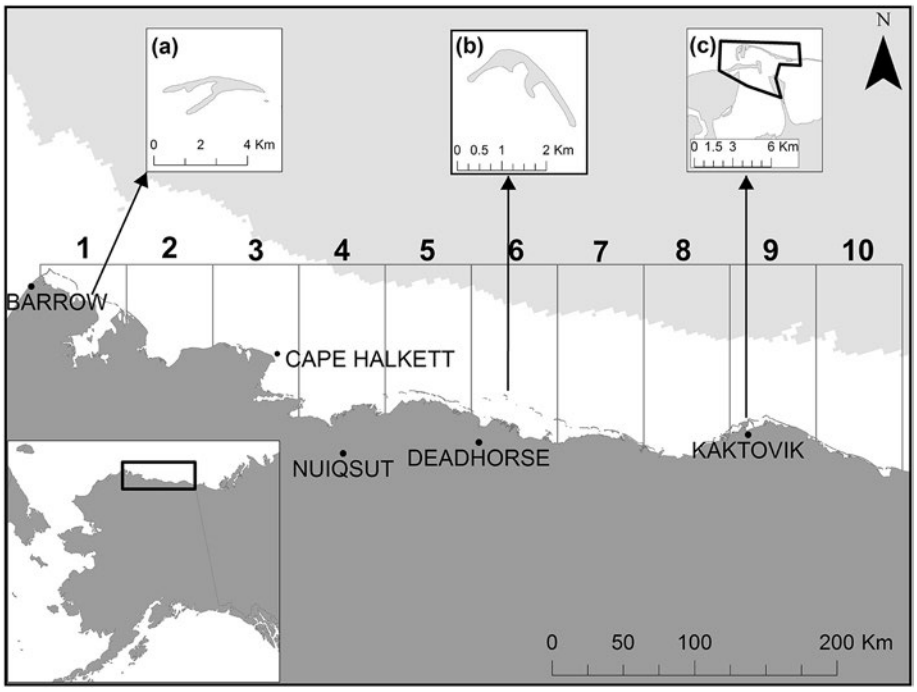


**Fig. 1.** Study area along the Beaufort Sea coast from Barrow, Alaska to the Canadian Border. The grids represent the 10 sub-regions of the study area for analysis (with each labeled with its grid number), white offshore areas are over the continental shelf (i.e., < 300 m depth), whereas light gray offshore areas are deeper waters (i.e., > 300 m depth). Sub-figures depict the location of focal count areas used in the analysis; a) Cooper Island, b) Cross Island, c) Barter Island. Within panel c, we further highlighted which area surrounding Barter Island was available for ground-based counts.

count data that helped to supplement periods when there were no data from aerial surveys. Our goal was to estimate the number of bears along the coastline (i.e., a linear feature) and not estimate the total number of polar bears on land during summer.

### 2.5. Process model

The true number of polar bears (i.e., the total number of polar bears along the coastline of the study region), $N$, on the coastline during week $i$, of year $t$, was modeled as a latent variable

$$N_{i,t} \sim \text{Poisson}(exp(\beta_{N0} + \boldsymbol{x}'_{\boldsymbol{N_{i,t}}}\boldsymbol{\beta_N})) \quad (1)$$

where $\beta_{N0}$ is an intercept term, $\boldsymbol{\beta_N}$ is a five element vector of regression coefficients, and $\boldsymbol{x_{Ni,t}}$ is the set of five explanatory variables present during week $i$, of year $t$. Specifically, $\boldsymbol{x_{Ni,t}}$ represents variables describing the weekly area of ice over the continental shelf, the annual date of ice retreat from the continental shelf, date of ice return over the continental shelf, the annual maximum distance from the ice edge to shore, and the average body mass index (BMI) of adult male polar bears from the SB subpopulation captured each spring (Supplementary appendix C).

To estimate what proportion of bears on the coastline (i.e., $N$) occurred in each grid cell (hereafter grid), we modeled the true proportion, $\psi$, of $N_{i,t}$ within each grid, $g$, as

$$\boldsymbol{\psi_{i,t}} \sim \text{Dirichlet}(exp(\beta_{n0} + \boldsymbol{x}'_{\boldsymbol{n_{g,i,t}}}\boldsymbol{\beta_n})) \quad (2)$$

where $\beta_{n0}$ is an intercept term, $\boldsymbol{\beta_n}$ is a six element vector of regression coefficients, and $\boldsymbol{x_{ng,i,t}}$ is the set of six explanatory variables present during week $i$, of year t, in grid $g$. Specifically, $\boldsymbol{x_{ng,i,t}}$ is represented by variables describing whether a grid contains a community that harvests bowhead whales, the weekly area of ice over the continental shelf within a grid, the annual date of ice retreat from, and return to, the continental shelf within a grid, the length of barrier islands within a grid, and whether a harvested bowhead whale carcass is present or absent in a grid during each week and year of the study. The estimated number of bears present within grid cells each week is therefore represented as

$$\boldsymbol{n_{i,t}} = N_{i,t}\boldsymbol{\psi_{i,t}} \quad (3)$$

For a description of how variables for estimating $N_{i,t}$ and $n_{g,i,t}$ were derived, see Supplementary appendix C.

### 2.6. Observation model

We modeled the number of polar bears observed during a survey (i.e., the sum of bear group sizes) as a function of $n_{g,i,t}$ and of the proportion of a grid surveyed. Given that bears are not equally distributed on barrier islands or the mainland coast, we accounted for the proportion of each that were sampled during each survey. We therefore modeled the effective proportion of each grid sampled as

$$logit(\phi_{g,i,t}) = \beta_{\phi 0} + \beta_{\phi 1} m_{g,i,t} + \beta_{\phi 2} b_{g,i,t} + \alpha_{g,i,t} \quad (4)$$

where $\phi_{g,i,t}$ is the effective proportion of grid $g$ surveyed, $\beta_{\phi 0}$ is an intercept term, $\beta_{\phi.}$ are regression coefficients, $m_{g,i,t}$ is the proportion of the mainland coast flown in a grid, $b_{g,i,t}$ is the proportion of barrier island coast flown in a grid, and $\alpha_{g,i,t}$ is a random effect. We included random effects to control for any additional variation that might exist in the relationship between polar bear use of barrier islands across the study area (e.g., if barrier islands in some grids were not preferable to polar bears for some reason). The observed number of bears in a grid during a survey, $\text{n}_{\text{obs}_{g,i,t}}$, was then modeled as

$$\text{n}_{obs_{g,i,t}} \sim \begin{cases} 0, & \text{if a grid was not surveyed} \\ Binomial(\phi_{g,i,t}, n_{g,i,t}), & \text{if a grid was surveyed} \end{cases} \quad (5)$$

Finally, the counts of polar bears on Barter ($\boldsymbol{Ba_{obs}}$), Cross ($\boldsymbol{Cr_{obs}}$), and Cooper Islands ($\boldsymbol{Co_{obs}}$) were modeled as a function of the number of bears in the respective grids (9, 6, and 1, respectively) and an estimate of the proportion of bears in each of the three grids ($\theta_{Ba_{i,t}}, \theta_{Cr_{i,t}}, \theta_{Co_{i,t}}$), found on the islands. Observed counts were then modeled as

$$Ba_{obs_{i,t}} \sim \text{Poisson}(n_{9,i,t}\theta_{Ba_{i,t}}) \quad (6)$$

with Cross and Cooper Islands being modeled similarly.

All regression coefficients (i.e., $\beta_*$) and random effects (i.e., $\alpha$) were given a vague normal prior with mean zero, and precision (i.e., 1/variance) of 0.1. Parameters for the proportion of bears in a grid counted by direct island counts ($\theta_{Ba_{i,t}}, \theta_{Cr_{i,t}}, \theta_{Co_{i,t}}$) were all given uniform priors ranging from 0 to 1. The posterior and joint distributions for our model are:

$$[\beta_N, \beta_\phi, \beta_n, \alpha, \theta_{Ba}, \theta_{Cr}, \theta_{Co}, \boldsymbol{N}, \boldsymbol{n} \mid \boldsymbol{n}_{obs}, \boldsymbol{Ba}_{obs}, \boldsymbol{Cr}_{obs}, \boldsymbol{Co}_{obs}]$$
$$\propto [\boldsymbol{N} \mid \beta_N][\boldsymbol{n}_{obs} \mid \boldsymbol{n}, \beta_\phi, \alpha][\boldsymbol{n} \mid \boldsymbol{N}, \beta_n][\boldsymbol{Ba}_{obs} \mid \boldsymbol{n}, \theta_{Ba}]$$
$$\times [\boldsymbol{Cr}_{obs} \mid \boldsymbol{n}, \theta_{Cr}][\boldsymbol{Co}_{obs} \mid \boldsymbol{n}, \theta_{Co}][\beta_N][\beta_\phi][\beta_n][\alpha][\theta_{Ba}][\theta_{Cr}][\theta_{Co}] \quad (7)$$

### 2.7. Model implementation

We fit our Bayesian hierarchical model using Markov Chain Monte Carlo (MCMC) implemented through the 'rjags' package (Plummer, 2015) to run the program JAGS (Plummer, 2003) from the R language and environment for statistical computing (R Core Development Team, 2014). We initialized two chains with separate starting values and allowed a burn in period of 2,000,000 iterations. We then obtained 1,000,000 iterations from each chain, and thinned each by 100, resulting in a total of 20,000 samples from the posterior distribution. We visually assessed each parameter for convergence and assessed parameter estimates for significance based on whether their 95% Credible Intervals (C.I.; based on quantiles) overlapped zero, similar to Hobbs et al. (2012).

We performed posterior predictive checks (Chambert et al., 2014) to determine how well the model fit our observed data (i.e., $n_{obs}$). We calculated Bayesian *P* values for three test statistics (Supplementary appendix D) and considered *P* values for test statistics between 0.1 and 0.9 to indicate a good fit for a given test statistic (Hobbs and Hooten, 2015). Code required for implementing the model is provided in Supplementary appendix E.

### 2.8. Management strategy assessment

Each autumn, whaling crews in Kaktovik attempt to harvest the community's allotment of bowhead whales (typically 1 3 whales; http://www.aewc alaska.com/bowhead quota.html; accessed 26 Oct 2016). After a whale is processed, the carcass is moved to the far eastern end of Barter Island, approximately 2.5 km from the residential area and draws large aggregations of polar bears (Miller et al., 2015). The proximity of the carcass to the community has led to increased human polar bear conflict in recent years resulting in the need for a polar bear deterrence program during the period of the year polar bears are aggregated near Kaktovik. There has also been a large increase in tourism leading to even more potential for conflict, especially given the easy access to the site of the whale carcass. For these reasons we focused on Kaktovik to address the management strategies given that the other two communities have much lower levels of human polar bear conflict during summer and autumn. We assessed the following strategies for dealing with carcasses to minimize conflict with bears: 1) whale carcasses are taken offshore and dumped in the ocean, and 2) the whale carcasses are moved to a section of beach farther away from the community. To assess strategy 1 (S1), we modified the 'whale carcass present/absent' variable to be 0 during all weeks for the grid containing Kaktovik. For strategy 2 (S2), we followed the same modifications as S1, except we set the 'whale carcass present/absent' variable in the grid to the east (i.e., 10) of the Kaktovik grid to be 1 during all weeks when a carcass was observed to be present in Kaktovik. Given the structure of our model, we did not account for how far the carcass was moved into grid 10, just that it was moved somewhere within that grid. For each strategy, all other variables were kept the same as originally observed. We then predicted the number of polar bears in the grid containing Kaktovik each week of the study under each scenario in the same MCMC routine described above.

## 3. Results

We flew a total of 53 surveys between 2000 and 2014, with an average of 3.8 (SD = 0.97) surveys flown per year. The distance flown in each survey varied (Table A1), but was on average 961 km (SD = 36.3). The mean number of polar bears observed during a survey was 64 (SD = 36), with a maximum of 156 observed during the late August survey of 2012. The mean number of polar bears counted per 100 km of survey was 7 (SD = 4), although distribution was not uniform along the coastline. We obtained polar bear counts on Cooper, Cross, and Barter islands during a total of 27, 9, and 59 weeks of the study, respectively. On Cooper Island, we observed an average of 0.7 (SD = 1.1) polar bears during each survey week, with a maximum of 5 bears observed during late August in 2002. On Cross Island, we observed an average of 6.4 (SD = 3.8) polar bears during each survey week, with a maximum of 13 bears observed the week of 19 September of 2004. Finally, on Barter Island, we observed an average of 35.2 (SD = 17.7) polar bears during each survey week, with a maximum of 80 polar bears observed during the week of 12 September 2012.

### 3.1. Model results

There was no indication of a lack of convergence for the model and all parallel chains converged. We did not observe any significant evidence of a lack of fit from our posterior predictive checks. Bayesian *P* values for the estimate of the total number of bears within each grid indicated a good model fit for each metric; mean ($P = 0.51$), standard deviation ($P = 0.58$), and discrepancy ($P = 0.50$).

We estimated the mean weekly number of bears (as a derived variable), annually, on the coastline between 2000 and 2014 to be 140 (95% C.I.: 127 157). While there was considerable variation in the weekly estimates of the number of bears on shore in the study region, we found no evidence suggesting an increasing annual trend in the number of polar bears on shore during the study period (Fig. 2).

The number of polar bears on shore each week was related to sea ice conditions (Table 1). The most significant predictors of the number of

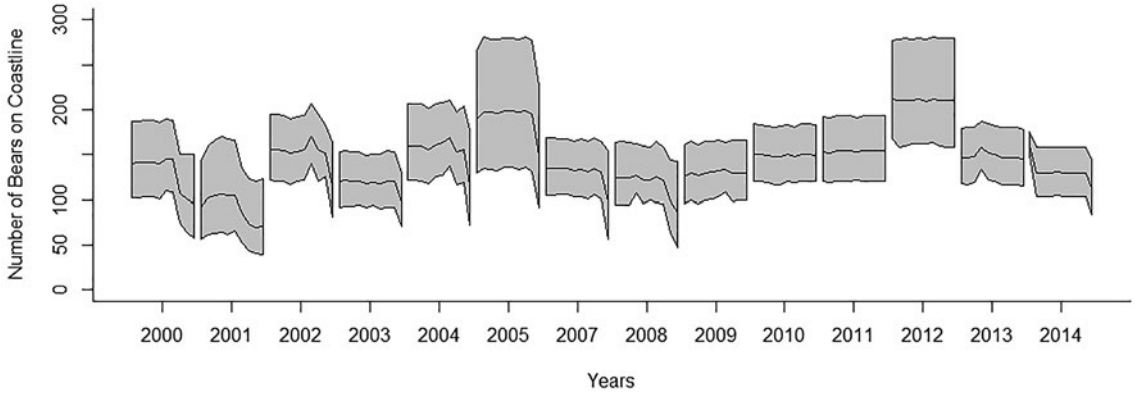


**Fig. 2.** Weekly estimates (solid line) of the number of polar bears along the coastline of Alaska, from Barrow to the Canadian Border, 2000–2014, excluding 2006. Gray shaded region presents the 95% Credible Intervals around weekly estimates.

**Table 1**
Summary statistics for coefficient estimates used to estimate the weekly number of polar bears along the northern Alaska coastline (*N-parameters*) and their distribution (*n-parameters*) between the last week of August and the last week of October 2000–2014, excluding 2006.

| | | | | Quantile | |
|---|---|---|---|---|---|
| Parameter | Mean | Median | SD | 0.025 | 0.975 |
| *N-parameters* | | | | | |
| Intercept | 4.03 | 4.03 | 0.29 | 3.46 | 4.60 |
| Ice area | 0.40 | 0.41 | 0.23 | 0.83 | 0.08 |
| Ice retreat date | 0.71 | 0.70 | 0.30 | 0.14 | 1.29 |
| Ice return date | 1.04 | 1.04 | 0.40 | 0.24 | 1.81 |
| Max distance to ice | 0.43 | 0.43 | 0.25 | 0.06 | 0.91 |
| Male BMI | 0.34 | 0.33 | 0.40 | 1.12 | 0.46 |
| *n-parameters* | | | | | |
| Intercept | 0.12 | 0.11 | 0.47 | 1.06 | 0.79 |
| Whale community | 0.18 | 0.18 | 0.26 | 0.33 | 0.71 |
| Ice area | 0.77 | 0.78 | 0.54 | 0.31 | 1.83 |
| Ice retreat date | 1.06 | 1.07 | 0.49 | 1.99 | 0.07 |
| Ice return date | 0.37 | 0.38 | 0.45 | 1.24 | 0.53 |
| Barrier islands | 0.64 | 0.65 | 0.30 | 0.03 | 1.21 |
| Whale carcass | 2.07 | 2.07 | 0.24 | 1.61 | 2.56 |

bears on shore (i.e., those that had 95% C.I. that did not overlap 0) was the date of ice retreat and return, with more bears being on shore in years with later dates of ice retreat and return (Table 1). We also found marginal support (i.e., within the 90% C.I.; −0.76 −0.01) for the variable associated with the amount of ice over the continental shelf, with fewer bears estimated to be on shore with increasing levels of sea ice over the continental shelf (Table 1). A similarly marginal relationship between weekly numbers of bears on shore and the maximum distance to sea ice from shore existed, with more bears estimated to be on shore in summers when ice was further from shore (Table 1). We found no evidence of average adult male BMI from the preceding spring capture season having an impact on the number of bears on shore (Table 1).

The estimated distribution of bears across the coast of northern Alaska was not uniform (Fig. 3). Grid 9 (the grid containing Kaktovik) had the highest estimated number of polar bears, with approximately 35% of polar bears on shore occurring there, on average, followed by grid 6 with approximately 25% (Fig. 3). Within Grid 9, 63.8% (95% C.I.: 58.4 68.9) of bears were estimated to be located on or adjacent to Barter Island (i.e., within the area depicted in Fig. 1c). Within Grid 6 (the grid containing Cross Island), 25.1% (95% C.I.: 14.4 38.8) were estimated to be on Cross Island.

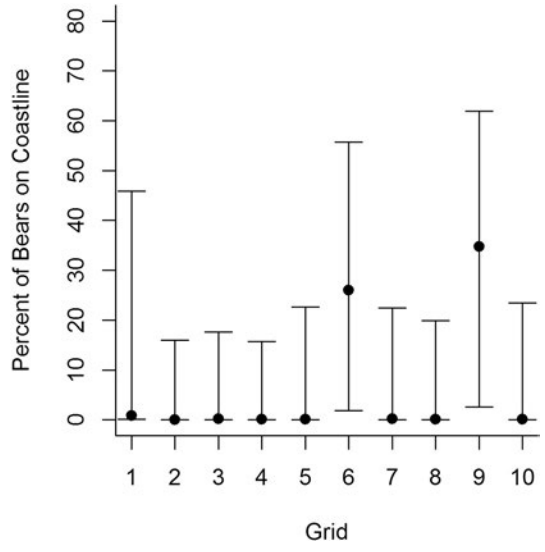


**Fig. 3.** Estimates of the mode percent ( ± 95% Credible Interval) of polar bears on the coastline of northern Alaska that occurred in each of 10 study grid cells during the study period, the last week of August through the last week of October 2000–2014, excluding 2006.

The two predominant factors that affected the distribution along the coastline were the presence/absence of a whale carcass in a grid and the date that sea ice retreated from that grid (Table 1). Bears were more likely to be distributed in sections of coast with earlier dates of ice retreat and a whale carcass present (Table 1). The distribution of bears was also positively affected by the relative availability of barrier islands along the coast (Table 1).

### 3.2. Management strategy

We observed significant reductions in the proportion of polar bears in the Kaktovik grid under both management scenarios compared to baseline conditions. Under S1, we found that disposing of whale carcasses in the ocean reduced the number of bears in the grid containing Kaktovik by 75% (95% C.I.: 65 84). Similarly, under S2 we found that moving whale remains further down the coast resulted in a 79% (95% C.I.: 69 87) reduction in the number of bears in the Kaktovik grid.

## 4. Discussion

Our modeling efforts allowed us to determine the relative influences of human activity, sea ice dynamics, and onshore habitat conditions on the number and distribution of polar bears on shore. While the number of bears on shore was related to sea ice dynamics, their onshore distribution was most strongly influenced by subsistence whaling activities. Given the link between the number of bears on shore and sea ice dynamics, there is likely little that can be done to reduce the number of bears coming to land. However, human polar bear conflict in coastal communities might be significantly reduced by managing attractants associated with harvested whales adjacent to communities. Interestingly, the presence of a whale carcass was > 11 times more important for determining the number of bears in a grid than whether the grid contained a whale community. This implies that polar bears in northern Alaska are not presently drawn to communities due to other attractants such as dumps (Towns et al., 2009). Thus, management activities associated with how whale carcasses are handled are likely to be the most influential in reducing human polar bear conflict in the region.

Even though the presence of a whale carcass was the primary factor influencing polar bear distribution, we also found evidence that sea ice conditions and the presence of barrier islands affected bear distribution. Therefore, even if the whale carcass was removed, sea ice conditions or the distribution of barrier islands adjacent to communities could still lead to bears posing problems to communities, especially if the proportion of the population using land in summer and autumn continues to increase (Atwood et al., 2016). This was highlighted by our finding that approximately 25% of polar bears that occurred in the grid containing Kaktovik would still remain even after whale carcasses were removed from the area. We also note that even though we did not observe a relationship between male BMI and the number of bears on the coastline, these results do not necessarily imply that a relationship with body condition and onshore behavior does not exist. We chose one sex/age class and spring condition as a potential indicator that may or may not have reflected condition of other sex and age classes or any class in the summer and autumn.

Although we found limited differences in the potential effectiveness of the two management scenarios, there are key difference between the two on how effective their actual implementation might be. The results of S1 might be overly optimistic if bears do not move elsewhere along the coast to find other sources of food (e.g., beach cast marine mammal carcasses). For example, Zieglstrum and Russell (2004) found that when supplemental food was removed for black bears, damage to conifers in

plantations increased seven fold for at least two years, implying that removal of an expected food source could lead to increased human conflict. Removing the whale carcass could also result in onshore polar bears shifting their focus to seeking foraging opportunities within the community itself (e.g., dumpsters) beyond what we found in this model. A similar pattern emerged with grizzly bears (*Ursus arctos*) in Yellowstone National Park, Wyoming; after dumps were shut down, grizzly bears increasingly used campgrounds, leading to a significant increase in conflict with humans and subsequently a large increase in bears killed (Craighead and Craighead, 1971). Thus, an immediate and complete elimination of whale carcasses could result in potential increases in defense of life kills and risks to human safety. Still, our model results for S1 likely reflect that there would be some reduction in bears in the grid containing Kaktovik given that such a large food subsidy had been removed.

Our management scenario analysis makes a number of assumptions that are important to consider when interpreting the results. We assume that if a whale is disposed of off shore, that the lack of carcass has no effect on the total number of bears that come to shore. We did not link the weekly estimate of *N* to any variable associated with whale harvest because, in all years of the study, communities harvested whales. Thus, if lack of carcasses near Kaktovik reduces the number of bears coming on shore, our estimated reduction in bears within the grid containing Kaktovik is likely underestimated. We also assume that there is no time lag between the management action and bear redistribution along the coast. The time lag is likely to differ between the two scenarios, with bears likely able to respond in near real time to moving a carcass down the coast, especially if the same location was used every year. Others have shown that black bears, for example, can quickly shift space use to reflect new food resources (Stringham and Bryant, 2015) or improved quality of existing food resources (Johnson et al., 2015). Conversely, polar bears might take multiple years to move away from Kaktovik if the carcasses were disposed offshore given that there was no 'new' food resource to exploit. This is especially true with evidence suggesting that polar bear use of subsistence harvested whales has a learned component, rather than simply opportunistic behavior (Herreman and Peacock, 2013). Given these uncertainties, even though the estimated reduction in polar bears in the grid containing Kaktovik was similar between scenarios, S2 might be the most likely to have a quicker realization of the desired management outcome.

Our results suggest that approximately 15% of the current SB subpopulation (Bromaghin et al., 2015) occurs along the northern Alaska coastline during any given week between late August and late October. Although we found no overall trend in the annual mean number of polar bears along the northern Alaska coastline, the fact that we estimated the highest number of bears on shore in 2012, the year that the minimum sea ice cover was recorded (Parkinson and Comiso, 2013), suggests that future sea ice loss could result in an increase of bears using land in summer.

We were somewhat surprised that we did not detect an increasing trend across years of the number of bears estimated to be on the coastline given that Atwood et al. (2016) found a significant increase in the proportion of collared adult females in the SB subpopulation using land during summer over a similar time frame. Although the results of Schliebe et al. (2008) also found no trend in the number of bears coming on shore between 2000 and 2005 for the SB subpopulation. A simple explanation of the discrepancy between our studies and those of Atwood et al. (2016) could be that the uncertainty around our estimates of *N* were too large to detect an increasing trend during our study period. Alternatively, our analysis estimated the total number of polar bears on the coastline, including all age and sex classes, whereas the study by Atwood et al. (2016) was restricted to adult females fitted with tracking collars. We believe the most likely explanation, however, is that Atwood et al. (2016) estimated the proportion of adult females coming on shore, whereas we estimated the absolute number of bears using the northern Alaskan coastline. If the size of the population remained stable during the course of our study, then trends in these two metrics should be similar. This is not the case, however, as the population size of the SB subpopulation has decreased from approximately 1500 animals in 2004 to 900 in 2010 (Bromaghin et al., 2015). Therefore, even if an increasing proportion of the population is using land, the absolute number may not have increased due to the concomitant decrease in population size during the study period.

Future research should continue to seek ways to integrate multiple data sets into the same analytical framework (given the flexibility of Bayesian models). This can be especially important for analyses similar to ours where one sampling method might be prone to incomplete surveys (e.g., helicopter surveys due to weather), and another method (e.g., ground based counts) could help fill those data gaps. Our study also provides an important framework for considering how various factors influence the spatial distribution of wildlife populations and what role climate change related distributional changes might play in increasing human wildlife conflict. Only by considering multiple factors associated with the number and distribution of polar bears on the coast were we able to discern what role human activities played in where bears occur and hence how successful efforts to manage the whale carcasses might be for reducing human polar bear conflict. Given the inability, in most situations, to perform large scale experiments to assess the value of different management options, implementing modeling approaches such as this can provide wildlife managers with important information on how best to use limited financial and human resources to minimize human wildlife conflict. Finally, if communities decide to move whale carcasses down the coast to manage polar bear human conflict, additional research should consider the optimal distance it should be moved and how prevailing wind directions in autumn might influence polar bear movements towards carcasses (Togunov et al., 2017).

Supplementary data to this article can be found online at http://dx.doi.org/10.1016/j.biocon.2017.08.005.

## Acknowledgments

The Bureau of Ocean Energy and Management (M09PG00024 and M09PG00025/0003) provided funding for this study. We would like to thank T. Evans, C. Perham, and pilots who assisted in data collection. We thank K. Rode, M. Hooten, J. Laufenberg, and W. Loya for valuable comments on an earlier version of this manuscript. The views of the USFWS authors in this publication are solely those of the USFWS authors, and do not necessarily represent the views of the USFWS. This article has been peer reviewed and approved by USGS under their Fundamental Science Practices policy (http://pubs.usgs.gov/circ/1367). Any use of trade, product or firm names is for descriptive purposes only and does not imply endorsement by the U.S. Government. This research was permitted under the Marine Mammal Protection Act and Endangered Species Act under U.S. Fish and Wildlife Service permit MA046081 and followed protocols approved by Animal Care and Use Committees of the U.S. Fish and Wildlife Service.

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**From:** Leonetti, Crystal
**To:** Miller, Susanne
**Cc:** James Wilder; Michelle StMartin; Ryan Wilson
**Subject:** Re: ABC News Terminology Question RE: Threatened vs Endangered
**Date:** Tuesday, November 14, 2017 11:56:39 AM

---

Thank you so much Susi!

*Crystal Leonetti*
Alaska Native Affairs Specialist
Alaska Region - R7 External Affairs **tEAm**
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"Consultation is a process that aims to create effective collaboration with Indian tribes and to inform Federal decision-makers. Consultation is built upon government-to-government exchange of information and promotes enhanced communication that emphasizes trust, respect, and shared responsibility. Communication will be open and transparent without compromising the rights of Indian tribes or the government-to-government consultation process." –S.O. 3317 (Department of the Interior Policy on Consultation with Indian Tribes)

On Tue, Nov 14, 2017 at 9:50 AM, Miller, Susanne <susanne_miller@fws.gov> wrote:

> As Jim said, humans and polar bears have both used Barter Island for as long as we know. In more "recent" times, one source (Arctic NWR Coastal Plain Resource Assessment, 1987) indicates that polar bears have sometimes aggregated at Barter Island since at least the mid-1980's. Similarly, Jacobson and Wentworth (1982) relate the availability of polar bears for subsistence harvest near the village in more recent years to the presence of whale carcasses and/or the dump.
>
> Some other key scientific findings:
>
> Koski et al (2005): Whale harvest records indicate that since about the early 1970s, one or more whales have been harvested at Barter almost every year (and presumably whale carcasses have been available to bears each of those years as well)
>
> Schliebe et al. (2008): during aerial surveys flown along the Beaufort Sea coast in 2000-2005, polar bear density was higher in areas where subsistence -harvested whale carcasses were present; highest proportion (about 70%) was observed at Barter Island. The spatial distribution (location) of bears on shore also co-incided with the areas where the distance to ice edge was shortest, and where a higher seal density occurred. In other words, Barter Island is a location where bears can not only avoid fasting when on land during the open water season, it is also an area where they have earlier access to ringed seals once landfast ice forms.
>
> Wilson et al. (2017) also found that polar bear distribution on shore was most strongly influenced by subsistence whaling activities (presence/absence of a carcass(es). Other factors included the presence/absence of barrier islands, and sea ice conditions (date of sea

ice retreat and return).

Atwood et al. (2016) found that the percentage of radio-collared adult females coming ashore has increased in the last 15 years (since about 2000), and that they are arriving earlier, staying longer once on shore.

So one way to discuss the overlap between bears and humans at Barter would be something like:

**While polar bears and humans have overlapped in their use of the Barter Island area for centuries, the presence of whale carcasses near Kaktovik in association with subsistence whaling has been reliable since at least the early 1970s, and appears to be a primary factor influencing where bears are located once they come to shore.**

Sorry for delay in getting this to you; I hope this helps. Please let me know if ABC want copies of additional citations (I have attached the ones I have as .pdfs)

Susanne (Susi) Miller, Wildlife Biologist, Polar Bears
U.S. Fish and Wildlife Service
Marine Mammals Management
1011 E. Tudor Road, MS-341
Anchorage, AK 99503
Tel. 907-786-3828
Fax 907-786-3816

On Mon, Nov 13, 2017 at 11:29 AM, Leonetti, Crystal <crystal_leonetti@fws.gov> wrote:

> Susi,
> Can you help me answer this question? (copying others in case you're unable to get to it quickly)
> *Crystal Leonetti*
> Alaska Native Affairs Specialist
> Alaska Region - R7 External Affairs tEAm
> U.S. Fish & Wildlife Service
> 1011 E. Tudor Road
> Anchorage, AK 99503
>
> Direct: 907-786-3868
> Mobile: 907-230-8419
>
> "Consultation is a process that aims to create effective collaboration with Indian tribes and to inform Federal decision-makers. Consultation is built upon government-to-government exchange of information and promotes enhanced communication that emphasizes trust, respect, and shared responsibility. Communication will be open and transparent without compromising the rights of Indian tribes or the government-to-government consultation process." –S.O. 3317 (Department of the Interior Policy on Consultation with Indian Tribes)
>
> ---------- Forwarded message ----------
> From: **Dawson, Durrell** <Durrell.Dawson@abc.com>
> Date: Mon, Nov 13, 2017 at 11:21 AM

Subject: RE: ABC News Terminology Question RE: Threatened vs Endangered
To: "Leonetti, Crystal" <crystal_leonetti@fws.gov>

Thanks Crystal,

And one more question for your team… do we know how long polar bears and humans have been in Kaktovik/Barter Island together?

James Wilder referenced the best available info and local knowledge from elders saying the polar bears were always present along the coast and around Kaktovik, but I'm wondering if we have any general idea range… like has it been just decades or centuries that both have been sharing the region? Thanks,

Durrell

**From:** Leonetti, Crystal [mailto:crystal_leonetti@fws.gov]
**Sent:** Monday, November 13, 2017 2:54 PM
**To:** Dawson, Durrell <Durrell.Dawson@abc.com>
**Subject:** Re: ABC News Terminology Question RE: Threatened vs Endangered

Hi Durrell,

Yes, Polar Bears are designated as threatened under the Endangered Species Act, and the Act says that a "threatened designation" means that the species is "likely to become endangered in the foreseeable future."

We are excited to see our people represented well on National news!

Crystal

*Crystal Leonetti*

Alaska Native Affairs Specialist

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On Mon, Nov 13, 2017 at 8:37 AM, Dawson, Durrell <Durrell.Dawson@abc.com> wrote:

> Hi Crystal,
>
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>
> Durrell
>
> **From:** Leonetti, Crystal [mailto:crystal_leonetti@fws.gov]
> **Sent:** Monday, November 06, 2017 8:22 PM
> **To:** Dawson, Durrell <Durrell.Dawson@abc.com>
> **Cc:** Andrea Medeiros <andrea_medeiros@fws.gov>
> **Subject:** Fwd: Permafrost - Kaktovik
>
> Hi Durrell,
>
> Attached are 3 papers and a recent newspaper article about ice cellars and permafrost. Below, see our scientist's response to your questions.

Permafrost is frozen soil, both near the surface and deeply buried. The Osterkamp paper provides data showing that the temperature of the permafrost on Barter Island has gotten warmer. When people say the permafrost is melting, what they mean is that just the top layer melts in summer, not all the deep permafrost. The ground is a frozen block of ice in winter. In summer, a layer at the top thaws back from the top. During warm summers the thawed layer is thicker. Water probably flows into the ice cellars. Summers are warmer now, so the summer thawed layer is getting thicker. In fall, it freezes back up to the surface again.

Regarding the second question, a number of studies show that coastal erosion rates on the north coast have increased since the 1970s and it is attributed to decreasing sea ice during the summer months. Most erosion happens during a few large storms with strong wind and waves. The only steep banks I know of on Barter Island are along coast or maybe along shore of lake, so the question in your email must have been about coastal banks. So the answer is that, yes, they are eroding faster now than before. The soil on Barter Island is full of huge wedges of ice. You can see the ice in places as you walk along the beach looking up at the bluffs. Once the ice is exposed to the air it melts rapidly. So the water does not have to be in contact with the ice to melt it. The sea water eats away at the bluff at the bottom, the bluff sluffs off and ice wedges high above the water are exposed to the air and start to melt.

Janet C. Jorgenson

Botanist

Arctic National Wildlife Refuge

101 12th Ave, Rm 236

Fairbanks, Alaska 99701

**From:** Leonetti, Crystal
**To:** Dawson, Durrell
**Subject:** Re: ABC News Terminology Question RE: Threatened vs Endangered
**Date:** Tuesday, November 14, 2017 12:01:09 PM

---

Durrell,

Sorry it takes me a bit to get back to you. I have to run your questions by a few people before I can respond. Here is the answer:

**Short Answer: Polar bears and humans have overlapped in their use of the Barter Island area for centuries. The presence of whale carcasses near Kaktovik in association with subsistence whaling has been reliable since at least the early 1970s, and appears to be a primary factor influencing where bears are located once they come to shore.**

Long Answer: As James Wilder said, humans and polar bears have both used Barter Island for as long as we know. In more "recent" times, one source (Arctic NWR Coastal Plain Resource Assessment, 1987) indicates that polar bears have sometimes aggregated at Barter Island since at least the mid-1980's. Similarly, Jacobson and Wentworth (1982) relate the availability of polar bears for subsistence harvest near the village in more recent years to the presence of whale carcasses and/or the dump.

Some other key scientific findings:

Koski et al (2005): Whale harvest records indicate that since about the early 1970s, one or more whales have been harvested at Barter almost every year (and presumably whale carcasses have been available to bears each of those years as well)

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Atwood et al. (2016) found that the percentage of radio-collared adult females coming ashore has increased in the last 15 years (since about 2000), and that they are arriving earlier, staying longer once on shore.

We have the references if you need them, just let me know!

Thanks for the great questions Durrell!
Crystal

*Crystal Leonetti*
Alaska Native Affairs Specialist
Alaska Region - R7 External Affairs **tEAm**
U.S. Fish & Wildlife Service
1011 E. Tudor Road
Anchorage, AK 99503

Direct: 907-786-3868
Mobile: 907-230-8419

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> We are excited to see our people represented well on National news!
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> Crystal
>
> *Crystal Leonetti*
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> Alaska Native Affairs Specialist
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> Alaska Region - R7 External Affairs tEAm

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Janet C. Jorgenson

Botanist

Arctic National Wildlife Refuge

101 12th Ave, Rm 236

Fairbanks, Alaska 99701

**From:** Leonetti, Crystal
**To:** Arthur, Stephen
**Subject:** Re: ANWR photo
**Date:** Tuesday, November 14, 2017 12:03:07 PM
**Attachments:** image001.png

---

OK, do you happen to know approximate month and date of the other photos and/or who took them? Sorry about spelling your last name wrong in the previous email.

*Crystal Leonetti*
Alaska Native Affairs Specialist
Alaska Region - R7 External Affairs **tEAm**
U.S. Fish & Wildlife Service
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On Tue, Nov 14, 2017 at 9:32 AM, Arthur, Stephen <stephen_arthur@fws.gov> wrote:

> Crystal,
>
> Regarding the caption for the photo of the Beaver flying over the Porcupine herd: that is an Alaska Dept of Fish and Game aircraft conducting a photo census of the herd on the coastal plain.
>
> Steve
>
> Stephen M. Arthur, Ph.D.
> *Supervisory Wildlife Biologist*
> *Arctic National Wildlife Refuge*
> *101 12th Ave., Room 236*
> *Fairbanks, AK 99701*
> *(907)455-1830*
>
> On Tue, Nov 14, 2017 at 8:41 AM, Leonetti, Crystal <crystal_leonetti@fws.gov> wrote:
>
> > Steve,
> > Mr. Joling is asking for caption information: Month and Year of the photo, plus photographer's name. If we don't know the photographer's name, we'll just use USFWS. I know the one with the Beaver in the photo is yours. I think it might be good if we use "Stephen M. Aurthur/USFWS" Are you OK with that?
> >
> > *Crystal Leonetti*
> > Alaska Native Affairs Specialist
> > Alaska Region - R7 External Affairs **tEAm**

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On Tue, Nov 14, 2017 at 7:45 AM, Arthur, Stephen <stephen_arthur@fws.gov> wrote:

> Crystal,
>
> I did find a copy of the photo they requested, but it is not of very high quality. I don't know if this will be sufficient. This one is also a FWS file photo.
>
> Steve
>
> Stephen M. Arthur, Ph.D.
> *Supervisory Wildlife Biologist*
> *Arctic National Wildlife Refuge*
> *101 12th Ave., Room 236*
> *Fairbanks, AK 99701*
> *(907)455-1830*
>
> On Tue, Nov 14, 2017 at 7:26 AM, Arthur, Stephen <stephen_arthur@fws.gov> wrote:
>
> > Crystal,
> >
> > I am working remotely so I do not have access to the Refuge photo library. I do have a couple of similar images on my computer (attached). The two ground-level photos (pch1 and pch2) are FWS file images; the aerial photo (pch and beaver) is one of my own.
> >
> > Perhaps someone at the Refuge can find the specific images from the brochure.
> >
> > Steve
> >
> > Stephen M. Arthur, Ph.D.
> > *Supervisory Wildlife Biologist*
> > *Arctic National Wildlife Refuge*
> > *101 12th Ave., Room 236*
> > *Fairbanks, AK 99701*
> > *(907)455-1830*
> >
> > On Mon, Nov 13, 2017 at 4:08 PM, Leonetti, Crystal <crystal_leonetti@fws.gov> wrote:
> >
> > > Dan Joling says, of the attached document:
> > >
> > > Crystal,

We like the photo on page 3 of the caribou with the mountains in the background. The one that says "Wildlife" in the upper right-hand corner.

We also like the one on page 7: the aerial view that shows thousands of caribou about he size of rice grains.

Thanks much.

I'm leaving now but will speak to you or Andrea on Tuesday.

Dan

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On Mon, Nov 13, 2017 at 3:46 PM, Leonetti, Crystal <crystal_leonetti@fws.gov> wrote:

> Hi Doug and Steve,
> Do you have any photos handy that would work for a very reliable Alaskan Associated Press journalist?
> Thanks!
> *Crystal Leonetti*
> Alaska Native Affairs Specialist
> Alaska Region - R7 External Affairs tEAm
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---------- Forwarded message ----------
From: **Joling, Dan** <djoling@ap.org>
Date: Mon, Nov 13, 2017 at 3:02 PM
Subject: ANWR photo
To: "Crystal_Leonetti@fws.gov" <Crystal_Leonetti@fws.gov>

Hi Crystal,

Just got an automatic email from Andrea saying she'd out of the office.

We're looking for an agency photo of caribou on the coastal plain of ANWR.

I looked in the USFWS digital archives and the selection is pretty limited, which makes me think I'm not very skilled at using your archives.

The Washington Post had a photo of caribou on the plain with the Brooks Range in the background. I didn't see it in the digital archives. Am I looking in the wrong place? Can you help?

Thanks,

Dan

**Dan Joling**

**Newsman**

**The Associated Press, Anchorage**

**(907)-272-7549, office**

**(907)-223-2111, cell**

and delete this email. Thank you.
[IP_US_DISC]


AP

**From:** Leonetti, Crystal
**To:** Dawson, Durrell
**Subject:** Re: ABC News Terminology Question RE: Threatened vs Endangered
**Date:** Tuesday, November 14, 2017 12:56:54 PM

---

That's excellent! Thanks for the update.

*Crystal Leonetti*
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On Tue, Nov 14, 2017 at 10:18 AM, Dawson, Durrell <Durrell.Dawson@abc.com> wrote:

> Thanks for clarifying Crystal. We are still on track to air tomorrow briefly on Good Morning America and then as a full show on Nightline (as long as there isn't breaking news). At this point both James Wilder and Todd Atwood will likely both be in the Nightline piece but Doug Damberg may not make it in. I'm not sure at this point if any of them are in the much shorter GMA spot. Thanks,
>
> Durrell
>
> **From:** Leonetti, Crystal [mailto:crystal_leonetti@fws.gov]
> **Sent:** Tuesday, November 14, 2017 2:01 PM
>
> **To:** Dawson, Durrell <Durrell.Dawson@abc.com>
> **Subject:** Re: ABC News Terminology Question RE: Threatened vs Endangered
>
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We are excited to see our people represented well on National news!

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Botanist

Arctic National Wildlife Refuge

101 12th Ave, Rm 236

Fairbanks, Alaska 99701

**From:** Wendy Loya
**To:** Paul Leonard
**Cc:** b6 @gmail.com
**Subject:** Draft for review: Notes from Arctic LCC Partners Meeting
**Date:** Tuesday, November 14, 2017 1:05:11 PM
**Attachments:** Notes Arctic LCC Partners meeting 111317.pdf

---

HI Paul,
Draft email to partners for your review…would like to send out today if possible.

Hi Arctic LCC Partners,

Thanks to everyone that was able to join yesterday's meeting. Paul and I really appreciate your time and ideas in thinking about next steps for the Arctic LCC. Attached is a PDF that has the very texty slides I shared throughout the meeting, with some of my notes summarized on page 10.

The action items from the meeting are:

- Work with North Slope Science Initiative (NSSI) Deputy Director ( Mark Miller) and Director (Sara Longan) on formalizing relationship between Arctic LCC and NSSI, engaging Senior Staff and their Oversight Group members to define roles.
- Arctic LCC Staff will begin to convene two working groups immediately: Cumulative Impacts Analysis and Caribou Connectivity. Please let us know if you are interested in participating in either; we will seek member recommendations from previous participants and work with agency staff and north slope organizations to solicit community input/local knowledge experts.
- Other working groups, including Hydrologic Monitoring and Modeling and Coastal/Marine spatial science will be scoped in early 2018. Send us additional ideas or needs anytime.
- As regional and national efforts come together to support applications for funding emerge, we'll be in touch!

I hope you all have a wonderful Thanksgiving and we'll be in touch again soon,
Wendy

Dr. Wendy M. Loya, Coordinator
Arctic Landscape Conservation Cooperative (LCC)
Anchorage, Alaska
907.786.3532 (office)
907.227.2942 (mobile)

# Arctic LCC Partners Meeting
# Nov 13th 1-3pm
# Suggested Agenda

Participants: Cherly Rosa, Mark Miller, Diane Granfors, Cathy Coon, Eva Patton, John Pearce, Steve Arthur, Ryan Toohey, Sue Rodman, Robyn Angliss, Amy Holman, Eric Wald, Joel Reynolds

- Introductions
- Summary from Alaska LCC Visioning Session Nov 1-2 hosted by Alaska Conservation Foundation
- Where to go with Arctic LCC under different funding scenarios
  - Future Structure
  - Future Function

# *Notes from facilitator for LCC Visioning*
# What are our CORE FUNCTIONS? What is WORKING WELL?

THEMES

- **Leadership on climate change and adaptation** – research, strategies
- **Not siloed** – synthesis of relevant information from multiple sources
- **Forum, convener** – bottom up and top down; a bridge across disciplines and organizations
- **Applied research** – research with a goal of informing land and resource management, community viability issues and options
- **Landscape scale** – ability to work across jurisdictional boundaries
- **Respect for different world views** – integration of "indigenous knowledge" and "science"
- **Partnerships-driven** – a focus on inclusivity, giving equal voices
- **Funding and capacity leverage(r)** – amplify, synthesize partner contributions
- **Place-based focused** – tie to specific geographies, on-the-ground issues
- **Educator and trainer**

# *Notes from facilitator for LCC Visioning*
# What COULD WORK BETTER or BE IMPROVED?

THEMES

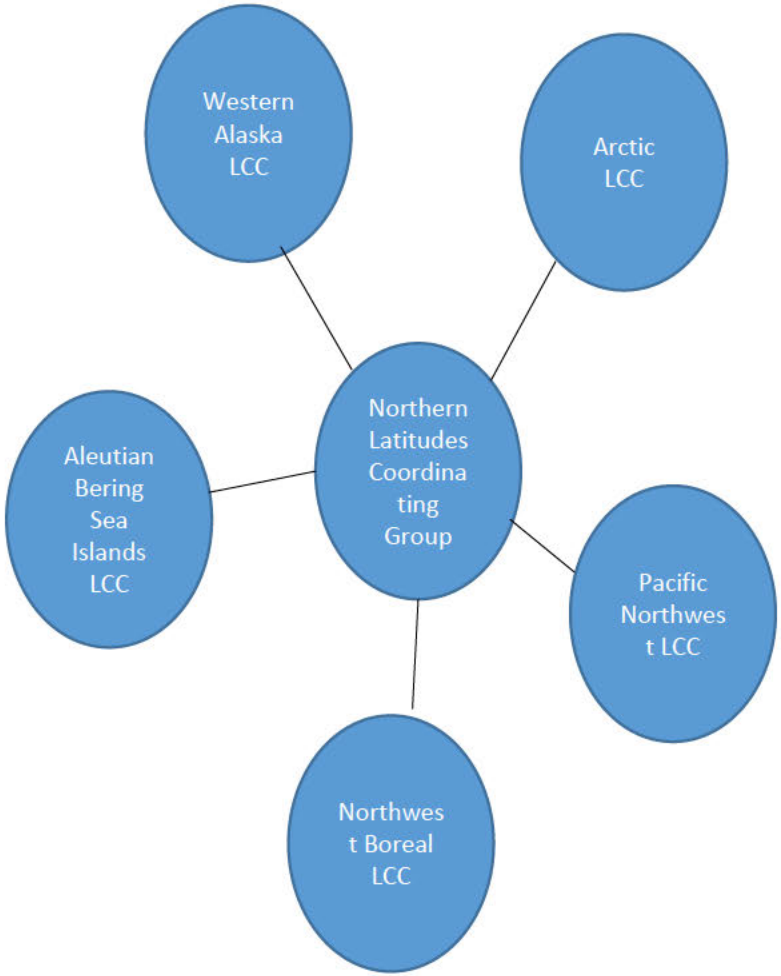
- **Message** – stronger, unified, compelling message and messaging plan, internal and external
- **Stronger, Wider Partnerships** – continue with agencies, researchers, communities, tribes; add Native Corporations, business and industry, consumptive/extractive and non
- **Implementation** – stronger follow through across LCC functions, better performance measures
- **Native Organizations** – further strengthen partnerships, help increase capacity, better representation in LCC staff and leadership
- **"Indigenous Knowledge & Science"** – respect differences, better take advantage of both worlds
- **Internal Governance & Organization** – develop sustainable, forward-looking cross-LCC structure, funding, tools, shared priorities
- **Maximize Value of Meetings/Workshops** – realism about time commitments, continued recognition about value and need for collaboration and communication

*Notes from facilitator for LCC Visioning*
Draft Summary of Ideas

- Retain 5 Northern Latitude LCCs
- Create Northern Latitudes Coordinating Group
- Request FWS continue to endorse LCCs
  - Retain innovative elements of LCCs in DOI
  - Federal sponsorship enables federal engagement
- Broaden funding strategy for LCC staff and LCC projects

# *Notes from Partner at LCC Visioning*
# *Draft* idea for Northern Latitudes Coordinating Group

- Comprised of LCC Coordinator/Partnership Director and Science Coordinators from all 5 Northern Latitude LCCs
- Non-authoritative group charged with coordinating issues for the common good, coordinating technical initiatives, coordinating responses, etc.
- Creates working groups on technical or policy issues that cross boundaries and support common goals among multiple LCCs



# *Notes from Partner at LCC Visioning*
# Draft Regional Funding Strategy

- LCC Federal Staff
  - Request FWS continue funding at least one US federal position per LCC
  - Request partners to contribute to other strategic staff positions through inter/intra agency fund transfers
  - Request funding from NGO/foundations through donation or Cooperative Research and Development Agreements (CRADA)
- LCC NGO Staff
  - Develop MOA with one or more NGO for LCC staff support
  - Request funding from partners or foundations directly to LCC NGO
- LCC Projects
  - LCC working groups partner to self-fund critical research needs
  - LCCs develop and publish prioritized lists of projects to attract funding from any source

# Arctic LCC Structure

- Building stronger partnership with Native Alaskans, State of Alaska are DOI stated priorities.
- Canadian partners are there but collaboration needs greater attention to flourish
- Similar participants across other organizations, like NSSI; maintain “implementation” niche
- Future Governance
  - FWS may not support convening Steering Committees
  - If no FWS support at all, do we want to try to continue as an LCC and what does that look like?
  - Formal or informal governance?
    - Steering Committee with limited membership
    - Broad inclusive partnership
    - No overarching Steering Committee, but Chairs of working groups provide leadership

# Arctic LCC Overview

- Arctic LCC has been productive in terms of tackling climate science needs identified by partners
  - 60 projects with more than 400 products
- Excellent examples of inter-organizational partnerships to tackle interdisciplinary science
- FWS funding has equalized funding across Alaska LCCs, and uncertain for future ($275,000 in FY 17)
- Technical expertise of federal staff:
  - Paul is Landscape Ecologist ready to tackle big, complex needs
  - Josh is Data/Programming expert
- Climate change is not a priority for Administration, but still important and part of research hypotheses
- Where can we best contribute in the next 4 years?

# Possible Future Focus Areas:

**Collaborative working groups that build of existing time and financial investment in research, while addressing current administration priorities**

Past Groups
Hydrology
Permaforst
Coastal
Species-Habitat
Geospatial

- Cumulative Impacts Analysis
  - Modeling examples that address species of interest for primary drivers of change (climate-driven habitat change, development impacts)
  - Convening expertise on development management and identifying critical research needs across Arctic to understand development impacts
- Caribou Connectivity (Landscape Conservation Design)
  - Providing science to identify how to maintain protected and connected terrestrial and aquatic habitats
  - Potential synergy with State ASTAR planning
  - Arctic-wide community concerns about both costs and benefits of increased infrastructure
- Hydrologic Monitoring and Modeling
  - If not TEON, what? What research is needed to inform current management needs and how can we better coordinate/leverage knowledge and funding?
- Oceans and/or Coastal Issues
  - What is not being done that we can contribute to? Previous Coastal tasks largely completed?
- Others?

# Discussion notes

- Formalize a functional relationship between NSSI and Arctic LCC
- All LCC meeting several years ago was helpful for understanding what else was going on and how it might be relevant across LCCs
- Synthesis is needed
- Two translation audiences for products:  managers and communities.
- Communities say they are not being heard, so collaboration is key.  Discussed how to do that in a region where they are asked to engage in regulation and science input frequently.
- Use NSSI recommendations matrix for ideas, details, validation of working group tasks
- CAFF, CBMP and other Arctic Council initiatives have value and greater awareness of products and discussions needed among federal partners. Also good examples of community engagement.  Also sharing Arctic LCC and other partner efforts with CAFF important.
- With regards to offshore needs and linking the land, fresh and salty waters, the One Health initiative of the SDWG might be a useful framework/forum. http://www.sdwg.org/wp-content/uploads/2014/03/Arctic-One-Health-handout-Nov2016.pdf
- AdaptAlaska is emerging as a place to share science with communities, AOOS and SeaGrant should also be at table as we scope Arctic LCC offshore working groups.

# NSSI Working Groups formed last week

## 2011 Barrow Workshop Working Group

- **Charge**: Evaluate how/if follow up is needed with Barrow to close out any incomplete activities that are not addressed in subsequent studies in 2011 report, and provide recommendation on those activities to full STAP for consideration and potential forwarding to OG.

## Aircraft Disturbance Working Group

- **Charge**: Pursue an improved understanding and suggest new strategies to address to local concerns on the issue of harassment of animals, birds, and hunters by low-flying aircraft on the North Slope. Provide to full STAP for consideration.

## Ecosystem-based habitat status monitoring (link with next)

- **Charge**: Create an approach for driving collaboration among stakeholders for ecosystem-based habitat status and trends monitoring relative to anthropogenic activities (not from natural variability or climate change, etc.) on North Slope.

## Focal / subsistence species distribution, abundance, and disturbance-response monitoring (link with previous)

- **Charge**: Create an approach (or synthesize / harmonizes existing approaches) for focal species distribution & abundance monitoring relative to anthropogenic activities (not from natural variability or climate change, etc.) on North Slope.

## Document TK specific to subsistence and impacts (climate change & anthropogenic)

- **Charge**: Produce a summary report that recommends a process to support the optimization of science studies and operations through the inclusion of TK and local knowledge. Also determine whether scope extends only to marine mammals or beyond.

# DOI Arctic Cumulative Impacts Workshop
# Executive Summary

Campbell Science Center - Anchorage, Alaska
April 12 -13, 2016

**Improved Collaboration and Communication**

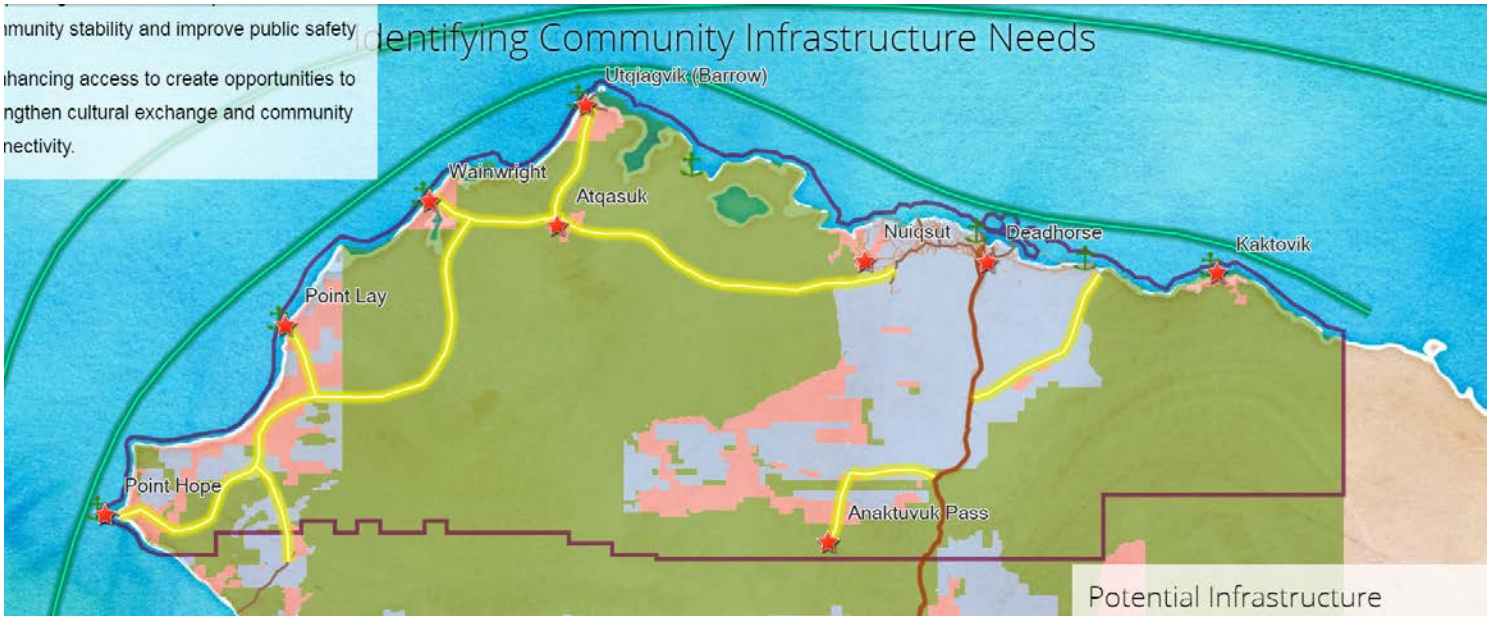
- Hold regular, cross-bureau NEPA coordinator meetings (in part, to facilitate the following recommendations).
- Develop a common language, clear objectives, and standard practices for use within NEPA and related documents for cumulative impacts analyses across bureaus.
- Develop CEQ-based, cumulative impacts analyses training and implement as required, with consistent training across bureaus.
- Each bureau create and save (in a shared space accessible by all bureaus) a consistently formatted, comprehensive, up-to-date list of past, current, and reasonably foreseeable actions.
- Review, and consistently leverage across all bureaus, any best practices and/or lessons learned related to ecosystem-based, broad scale cumulative impacts analyses work completed by the Arctic Council working groups (e.g., CAFF, PAME, and SDWG).

**Enhanced Integration**

- Develop a platform/clearinghouse/database for comprehensive, up-to-date information and geospatial data on past, current, and reasonably foreseeable actions, where all bureaus access and work from the same database (perhaps maintained by NSSI).
- **Create a shared, comprehensive, land and seascape scale, ecosystem-based, geospatial model to support fully integrated cumulative impacts analyses, where all bureaus are working from and maintaining the same geodatabases and maps (development leveraging NSSI STAP).**
- Support hiring a cross-bureau landscape and seascape coordinator (not a manager, but expertise and capacity to work across and within bureaus) to support Arctic cumulative impacts analysis integration and advancement, possibly stationed at DOI Alaska Secretary's Office.

# Arctic Strategic Transportation and Resources – ASTAR

http://soa-dnr.maps.arcgis.com/apps/Cascade/index.html?appid=ab8be9349a08477ebfb66d017e0aec8d

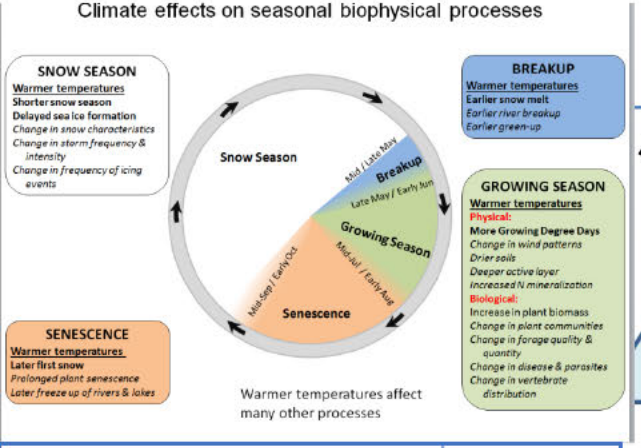


The following slides were not presented at Arctic LCC meeting, but were presented to NSSI Oversight Group (OG) on Weds Nov 8th.
General representation of foundation for Cumulative Effects Modeling.

Arctic Landscape Conservation Cooperative

Advancing Science, Understanding Change.

# Quantitative Cumulative Effects Modeling: integrating climate and development impacts




Conceptual models in Arctic LCC Species and Habitat Working Group reports

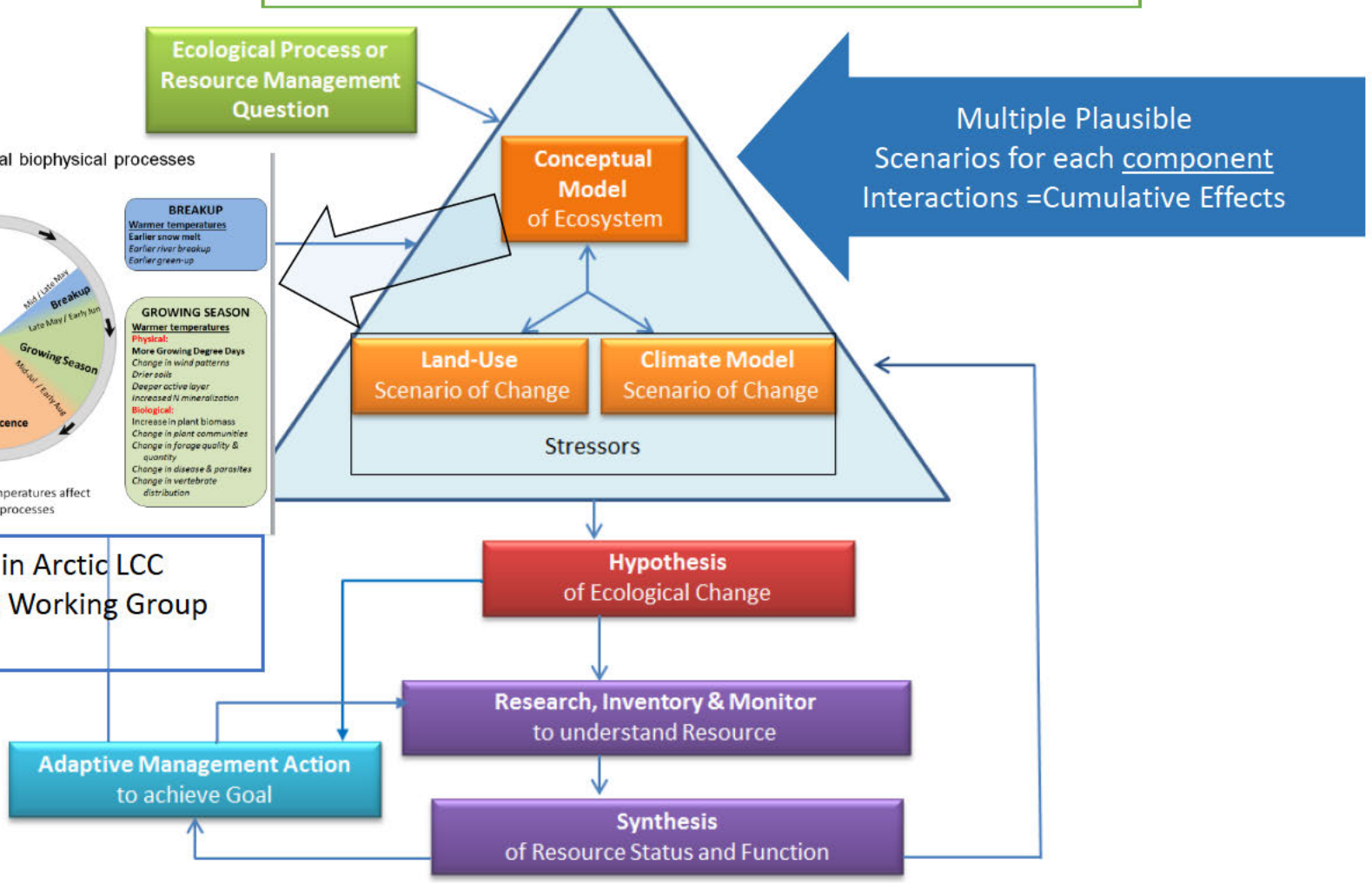



Figure by Wendy Loya

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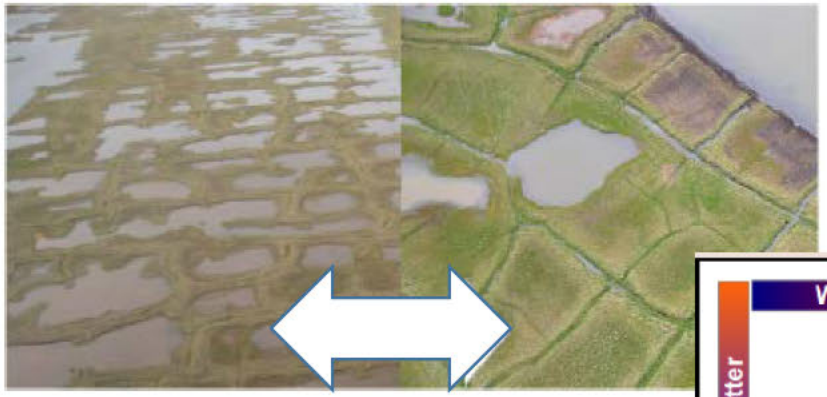
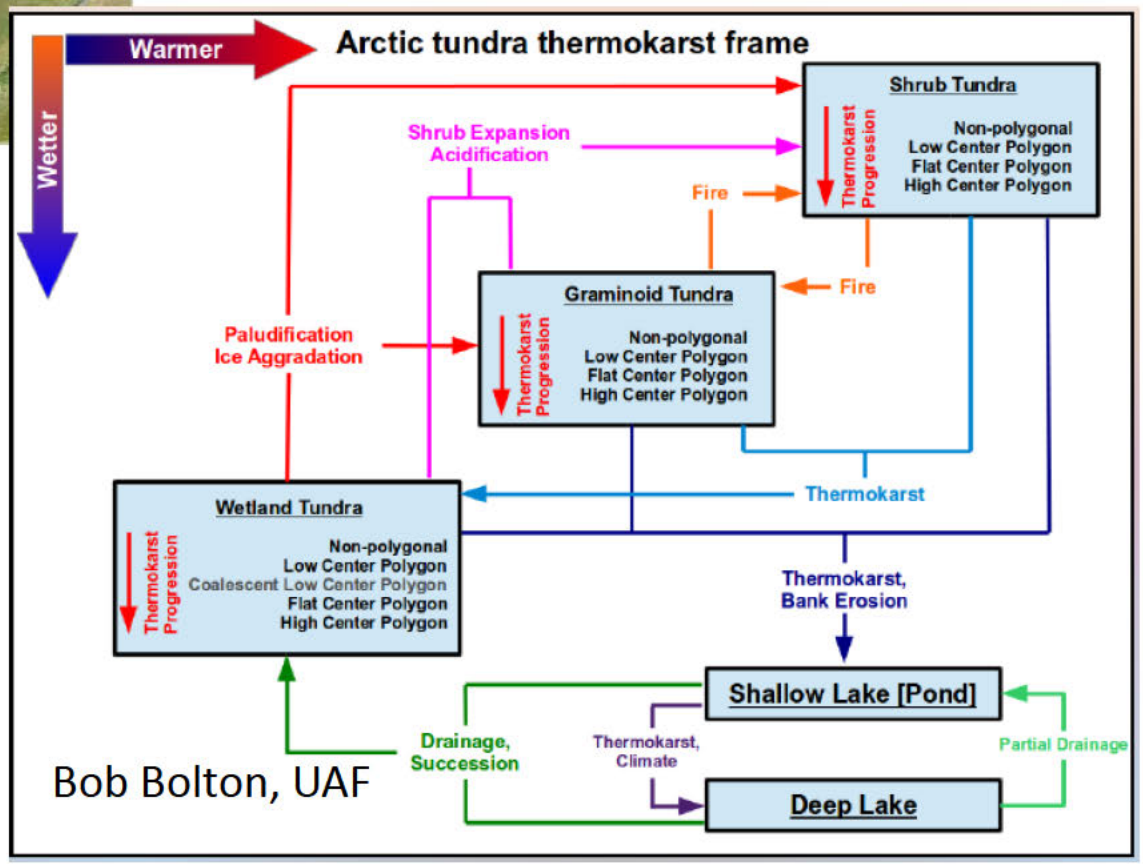


## Predicting future landcover: Integrated Ecosystem Model and Alaska Thermokarst Model (ATM)

Climate Science Center, LCCs, SNAP-UAF

ATM will model landform transition associated with increasing active layer for climate scenarios

Plugged into IEM, we can project habitat change and landform stability

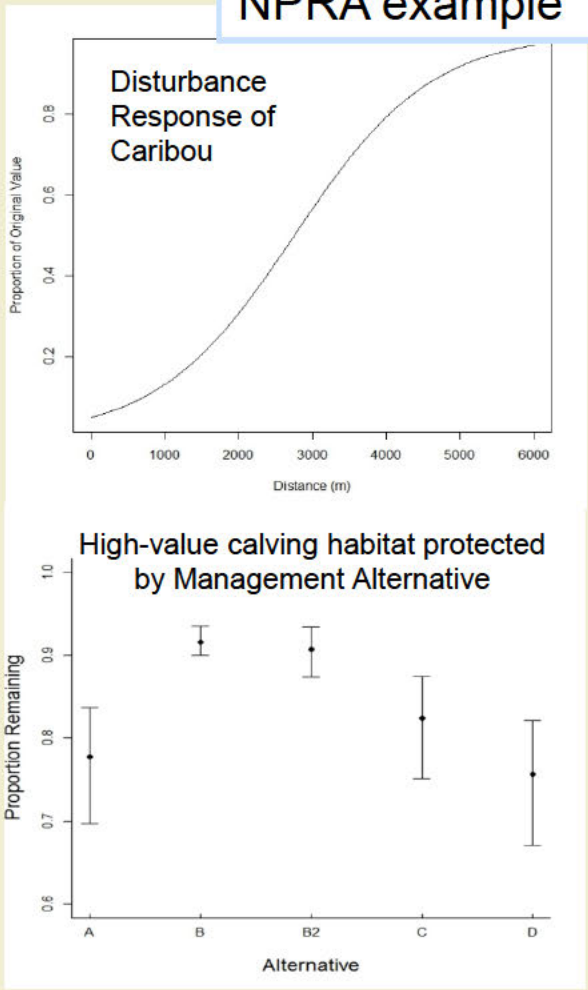


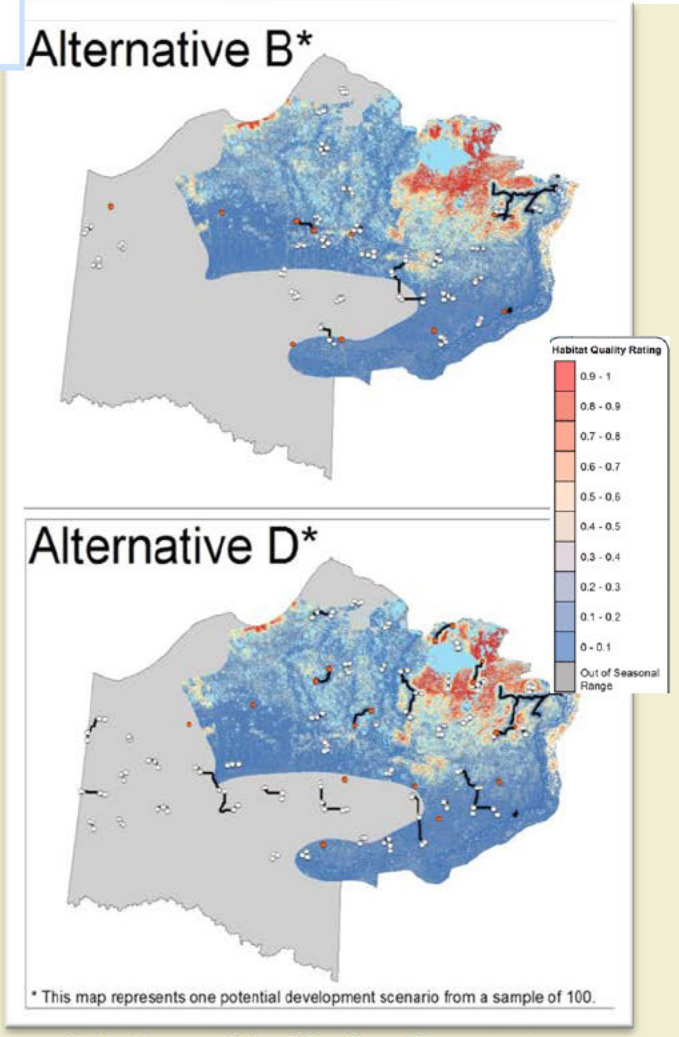

Bob Bolton, UAF

# Evaluating Climate and Oil & Gas Development impacts on High-value Habitats for Species of Interest

- Understand which habitats species use when
- Climate change projections of habitat shifts
- Probabilistic, iterative (100x) development model to account for uncertainty in where oil & gas might be discovered
- Habitat value discounted based on emperical response of species to development
- Quantitative results showing management implications for valued resources.

NPRA example





RR Wilson, AK Prichard, LS Parrett, BT Person, GM Carroll, MA Smith, .et al. 2012. Summer Resource Selection and Identification of Important Habitat Prior to Industrial Development for the Teshekpuk Caribou Herd in Northern Alaska. PloS one 7 (11), e48697

Wilson, R. R., Liebezeit, J. R. and Loya, W. M. (2013), Accounting for uncertainty in oil and gas development impacts to wildlife in Alaska. Conservation Letters, 6: 350–358.

**From:** Dawson, Durrell
**To:** Leonetti, Crystal
**Subject:** RE: ABC News Terminology Question RE: Threatened vs Endangered
**Date:** Tuesday, November 14, 2017 1:32:37 PM

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That's excellent! Thanks for the update.

*Crystal Leonetti*
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**Short Answer: Polar bears and humans have overlapped in their use of the Barter Island area for centuries. The presence of whale carcasses near Kaktovik in association with subsistence whaling has been reliable since at least the early 1970s, and appears to be a primary factor influencing where bears are located once they come to shore.**

Long Answer: As James Wilder said, humans and polar bears have both used Barter Island for as long as we know. In more "recent" times, one source (Arctic NWR Coastal Plain Resource Assessment, 1987) indicates that polar bears have sometimes aggregated at Barter Island since at least the mid-1980's. Similarly, Jacobson and Wentworth (1982) relate the availability of polar bears for subsistence harvest near the village in more recent years to the presence of whale carcasses and/or the dump.

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Thanks for the great questions Durrell!
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> Regarding the second question, a number of studies show that coastal erosion rates on the north coast have increased since the 1970s and it is attributed to decreasing sea ice during the summer months. Most erosion happens during a few large storms with strong wind and waves. The only steep banks I know of on Barter Island are along coast or maybe along shore of lake, so the question in your email must have been about coastal banks. So the answer is that, yes, they are eroding faster now than before. The soil on Barter Island is full of huge wedges of ice. You can see the ice in places as you walk along the beach looking up at the bluffs. Once the ice is exposed to the air it melts rapidly. So the water does not have to be in contact with the ice to melt it. The sea water eats away at the bluff at the bottom, the bluff sluffs off and ice wedges high above the water are exposed to the air and start to melt.
>
> Janet C. Jorgenson
> Botanist
> Arctic National Wildlife Refuge
> 101 12th Ave, Rm 236
> Fairbanks, Alaska 99701

**From:** Crystal Leonetti
**To:** Dawson, Durrell
**Subject:** Re: ABC News Terminology Question RE: Threatened vs Endangered
**Date:** Tuesday, November 14, 2017 1:34:25 PM

---

Ok, thanks for the heads up

Sent from my iPhone

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>
> Permafrost is frozen soil, both near the surface and deeply buried. The Osterkamp paper provides data showing that the temperature of the permafrost on Barter Island has gotten warmer. When people say the permafrost is melting, what they mean is that just the top layer melts in summer, not all the deep permafrost. The ground is a frozen block of ice in winter. In summer, a layer at the top thaws back from the top. During warm summers the thawed layer is thicker. Water probably flows into the ice cellars. Summers are warmer now, so the summer thawed layer is getting thicker. In fall, it freezes back up to the surface again.

Regarding the second question, a number of studies show that coastal erosion rates on the north coast have increased since the 1970s and it is attributed to decreasing sea ice during the summer months. Most erosion happens during a few large storms with strong wind and waves. The only steep banks I know of on Barter Island are along coast or maybe along shore of lake, so the question in your email must have been about coastal banks. So the answer is that, yes, they are eroding faster now than before. The soil on Barter Island is full of huge wedges of ice. You can see the ice in places as you walk along the beach looking up at the bluffs. Once the ice is exposed to the air it melts rapidly. So the water does not have to be in contact with the ice to melt it. The sea water eats away at the bluff at the bottom, the bluff sluffs off and ice wedges high above the water are exposed to the air and start to melt.

Janet C. Jorgenson
Botanist
Arctic National Wildlife Refuge
101 12th Ave, Rm 236
Fairbanks, Alaska 99701

**From:** Arthur, Stephen
**To:** Leonetti, Crystal
**Subject:** Re: ANWR photo
**Date:** Tuesday, November 14, 2017 1:46:35 PM
**Attachments:** image001.png

---

I believe that was taken in June of 1998.

Steve

Stephen M. Arthur, Ph.D.
*Supervisory Wildlife Biologist*
*Arctic National Wildlife Refuge*
*101 12th Ave., Room 236*
*Fairbanks, AK 99701*
*(907)455-1830*

On Tue, Nov 14, 2017 at 10:57 AM, Leonetti, Crystal <crystal_leonetti@fws.gov> wrote:

> And how about the one by you? Year and month (approximate is fine)?
>
> *Crystal Leonetti*
> Alaska Native Affairs Specialist
> Alaska Region - R7 External Affairs tEAm
> U.S. Fish & Wildlife Service
> 1011 E. Tudor Road
> Anchorage, AK 99503
>
> Direct: 907-786-3868
> Mobile: 907-230-8419
>
> "Consultation is a process that aims to create effective collaboration with Indian tribes and to inform Federal decision-makers. Consultation is built upon government-to-government exchange of information and promotes enhanced communication that emphasizes trust, respect, and shared responsibility. Communication will be open and transparent without compromising the rights of Indian tribes or the government-to-government consultation process." –S.O. 3317 (Department of the Interior Policy on Consultation with Indian Tribes)
>
> On Tue, Nov 14, 2017 at 10:31 AM, Arthur, Stephen <stephen_arthur@fws.gov> wrote:
>
> > I do not know that. Those photos were probably taken in the early 1990s but I don't know by whom.
> >
> > Steve
> >
> > Stephen M. Arthur, Ph.D.
> > *Supervisory Wildlife Biologist*
> > *Arctic National Wildlife Refuge*
> > *101 12th Ave., Room 236*
> > *Fairbanks, AK 99701*
> > *(907)455-1830*
> >
> > On Tue, Nov 14, 2017 at 10:02 AM, Leonetti, Crystal <crystal_leonetti@fws.gov> wrote:
> >
> > > OK, do you happen to know approximate month and date of the other photos and/or who took them? Sorry about spelling your last name wrong in the previous email.

*Crystal Leonetti*
Alaska Native Affairs Specialist
Alaska Region - R7 External Affairs tEAm
U.S. Fish & Wildlife Service
1011 E. Tudor Road
Anchorage, AK 99503

Direct: 907-786-3868
Mobile: 907-230-8419

"Consultation is a process that aims to create effective collaboration with Indian tribes and to inform Federal decision-makers. Consultation is built upon government-to-government exchange of information and promotes enhanced communication that emphasizes trust, respect, and shared responsibility. Communication will be open and transparent without compromising the rights of Indian tribes or the government-to-government consultation process." –S.O. 3317 (Department of the Interior Policy on Consultation with Indian Tribes)

On Tue, Nov 14, 2017 at 9:32 AM, Arthur, Stephen <stephen_arthur@fws.gov> wrote:

> Crystal,
>
> Regarding the caption for the photo of the Beaver flying over the Porcupine herd: that is an Alaska Dept of Fish and Game aircraft conducting a photo census of the herd on the coastal plain.
>
> Steve
>
> Stephen M. Arthur, Ph.D.
> *Supervisory Wildlife Biologist*
> *Arctic National Wildlife Refuge*
> *101 12th Ave., Room 236*
> *Fairbanks, AK 99701*
> *(907)455-1830*
>
> On Tue, Nov 14, 2017 at 8:41 AM, Leonetti, Crystal <crystal_leonetti@fws.gov> wrote:
>
> > Steve,
> > Mr. Joling is asking for caption information: Month and Year of the photo, plus photographer's name. If we don't know the photographer's name, we'll just use USFWS. I know the one with the Beaver in the photo is yours. I think it might be good if we use "Stephen M. Aurthur/USFWS" Are you OK with that?
> >
> > *Crystal Leonetti*
> > Alaska Native Affairs Specialist
> > Alaska Region - R7 External Affairs tEAm
> > U.S. Fish & Wildlife Service
> > 1011 E. Tudor Road
> > Anchorage, AK 99503
> >
> > Direct: 907-786-3868
> > Mobile: 907-230-8419

"Consultation is a process that aims to create effective collaboration with Indian tribes and to inform Federal decision-makers. Consultation is built upon government-to-government exchange of information and promotes enhanced communication that emphasizes trust, respect, and shared responsibility. Communication will be open and transparent without compromising the rights of Indian tribes or the government-to-government consultation process." –S.O. 3317 (Department of the Interior Policy on Consultation with Indian Tribes)

On Tue, Nov 14, 2017 at 7:45 AM, Arthur, Stephen <stephen_arthur@fws.gov> wrote:

> Crystal,
>
> I did find a copy of the photo they requested, but it is not of very high quality. I don't know if this will be sufficient. This one is also a FWS file photo.
>
> Steve
>
> Stephen M. Arthur, Ph.D.
> *Supervisory Wildlife Biologist*
> *Arctic National Wildlife Refuge*
> *101 12th Ave., Room 236*
> *Fairbanks, AK 99701*
> *(907)455-1830*

On Tue, Nov 14, 2017 at 7:26 AM, Arthur, Stephen <stephen_arthur@fws.gov> wrote:

> Crystal,
>
> I am working remotely so I do not have access to the Refuge photo library. I do have a couple of similar images on my computer (attached). The two ground-level photos (pch1 and pch2) are FWS file images; the aerial photo (pch and beaver) is one of my own.
>
> Perhaps someone at the Refuge can find the specific images from the brochure.
>
> Steve
>
> Stephen M. Arthur, Ph.D.
> *Supervisory Wildlife Biologist*
> *Arctic National Wildlife Refuge*
> *101 12th Ave., Room 236*
> *Fairbanks, AK 99701*
> *(907)455-1830*

On Mon, Nov 13, 2017 at 4:08 PM, Leonetti, Crystal <crystal_leonetti@fws.gov> wrote:

> Dan Joling says, of the attached document:
>
> > Crystal,
> >
> > We like the photo on page 3 of the caribou with the mountains in the background. The one that says "Wildlife" in the upper right-hand corner.
> >
> > We also like the one on page 7: the aerial view that shows thousands of caribou about he size of rice grains.

Thanks much.

I'm leaving now but will speak to you or Andrea on Tuesday.

Dan

*Crystal Leonetti*
Alaska Native Affairs Specialist
Alaska Region - R7 External Affairs tEAm
U.S. Fish & Wildlife Service
1011 E. Tudor Road
Anchorage, AK 99503

Direct: 907-786-3868
Mobile: 907-230-8419

"Consultation is a process that aims to create effective collaboration with Indian tribes and to inform Federal decision-makers. Consultation is built upon government-to-government exchange of information and promotes enhanced communication that emphasizes trust, respect, and shared responsibility. Communication will be open and transparent without compromising the rights of Indian tribes or the government-to-government consultation process." –S.O. 3317 (Department of the Interior Policy on Consultation with Indian Tribes)

On Mon, Nov 13, 2017 at 3:46 PM, Leonetti, Crystal <crystal_leonetti@fws.gov> wrote:

> Hi Doug and Steve,
> Do you have any photos handy that would work for a very reliable Alaskan Associated Press journalist?
> Thanks!
> *Crystal Leonetti*
> Alaska Native Affairs Specialist
> Alaska Region - R7 External Affairs tEAm
> U.S. Fish & Wildlife Service
> 1011 E. Tudor Road
> Anchorage, AK 99503
>
> Direct: 907-786-3868
> Mobile: 907-230-8419
>
> "Consultation is a process that aims to create effective collaboration with Indian tribes and to inform Federal decision-makers. Consultation is built upon government-to-government exchange of information and promotes enhanced communication that emphasizes trust, respect, and shared responsibility. Communication will be open and transparent without compromising the rights of Indian tribes or the government-to-government consultation process." –S.O. 3317 (Department of the Interior Policy on Consultation with Indian Tribes)
>
> ---------- Forwarded message ----------
> From: **Joling, Dan** <djoling@ap.org>
> Date: Mon, Nov 13, 2017 at 3:02 PM
> Subject: ANWR photo

To: "Crystal_Leonetti@fws.gov" <Crystal_Leonetti@fws.gov>

Hi Crystal,

Just got an automatic email from Andrea saying she'd out of the office.

We're looking for an agency photo of caribou on the coastal plain of ANWR.

I looked in the USFWS digital archives and the selection is pretty limited, which makes me think I'm not very skilled at using your archives.

The Washington Post had a photo of caribou on the plain with the Brooks Range in the background. I didn't see it in the digital archives. Am I looking in the wrong place? Can you help?

Thanks,

Dan

**Dan Joling**

**Newsman**

**The Associated Press, Anchorage**

**(907)-272-7549, office**

**(907)-223-2111, cell**


AP

**From:** Gale, Michael
**To:** Damberg, Doug
**Cc:** Patel, Kashyap; Morris, Charisa; Jim Kurth
**Subject:** Re: International Porcupine Caribou Board
**Date:** Tuesday, November 14, 2017 1:54:04 PM
**Attachments:** Porcupine.Caribou.Herd.Board.Agreement.pdf
BP Arctic Refuge Porcupine Caribou Board.docx

---

+ Jim Kurth

Please direct that all inquiries and requests on this issue through Jim Kurth, Deputy Director for Operations, at jim_kurth@fws.gov or 202.208.4545. I will ask Shawn Finley offline to also coordinate with Jim through her appropriate channels within the Solicitor's Office.

Attached is a cleared briefing paper of information on this issue, in case that is helpful in responding to inquiries.

Thanks,

Michael

On Mon, Nov 6, 2017 at 7:38 AM, Patel, Kashyap <kashyap_patel@fws.gov> wrote:

> Hi Doug,
>
> That's a very reasonable question. I requested that BP while in my temporary role in the Director's office augmenting the Chief of Staff. I would refer you Michael Gale who was staffing the follow-on coordination with State on IPCB-related issues when I left.
>
> However, because I believe Michael may be TDY this week, then I believe Charisa would be the most appropriate person to coordinate these inquiries, but I could be mistaken as I've been out of that role for a little while.
>
> Please let me know if there's anything else I can help with,

> Kashyap
>
> On Fri, Nov 3, 2017 at 8:24 PM, Damberg, Doug <doug_damberg@fws.gov> wrote:
>
> > Hi Kashyap:
> > Our R7 International Affairs Specialist in Region 7 has been receiving a handful of inquiries about the International Porcupine Caribou Board from DOI and the State Department. Do you know who in FWS would be the appropriate person in FWS HQ to direct these inquiries to? If not, who else would you recommend asking? I'm checking with you based on your recent request for the IPCB BP that we helped prepare.
> > Thanks!
> > d
> >
> > Doug Damberg
> > Refuge Supervisor, AK North Zone
> > U.S. Fish and Wildlife Service
> > 1011 E. Tudor Rd.; Anchorage, AK 99503
> > Office: (907) 786-3329

Cell: (907) 947-6302

---------- Forwarded message ----------
From: **Castellanos, Gilbert** <gilbert_castellanos@fws.gov>
Date: Fri, Nov 3, 2017 at 12:36 PM
Subject: Fwd: International Porcupine Caribou Board
To: Doug Damberg <doug_damberg@fws.gov>
Cc: Mitch Ellis <mitch_ellis@fws.gov>

Hi Doug,

As we discussed, there have been a number of inquiries from DOI and Department of State regarding the International Porcupine Caribou Board. Can you let me know who at FWS is coordinating our overall response on the IPCB? Feel free to send this along to them, or let me know if I should respond. I'll send you a couple more inquiries that have come in. I responded to all of these with a phone call, but didn't reach anyone, so I just left them a voicemail saying we'd be in touch by email.

Gil-

---------- Forwarded message ----------
From: **Finley, Rebecca** <shawn.finley@sol.doi.gov>
Date: Mon, Oct 16, 2017 at 10:32 AM
Subject: International Porcupine Caribou Board
To: Gilbert Castellanos <gilbert_castellanos@fws.gov>

Gilbert,

I'm an attorney in the Fish and Wildlife Branch of the Solicitor's Office at Headquarters, and, among other things, my practice involves international wildlife issues. I received inquiries from my management about the obligations of the FWS under the Agreement.

Accordingly, I thought you may be an appropriate contact in FWS to inquire about whether the Service has any historical documents surrounding the negotiation of the Agreement (for instance, an EIS was prepared when the Department of State was considering whether to enter into negotiations with Canada) or any agency documents describing FWS' role in implementation of the Agreement. If you have any documents that may be relevant here or if you could point me to someone who may have these kinds of documents, could you let me know?

Much obliged,

Shawn Finley

--
Shawn Finley
Attorney-Advisor

Office of the Solicitor, Branch of Fish and Wildlife
U.S. Department of the Interior
1849 C Street, NW
Washington, DC 20240
Phone: 202-208-3972
Fax: 202-208-3877



--

Gilbert Castellanos
International Affairs Specialist

U.S. Fish and Wildlife Service - Alaska Region
Office of International Conservation
1011 E. Tudor Road, MS 281
Anchorage, Alaska 99503

E-mail: Gilbert_Castellanos@fws.gov
Phone: 907-786-3850
Fax: 907-786-3303

--

Kashyap Patel
Management Analyst
Division of Policy, Performance, and Management Programs
U.S. Fish and Wildlife Service
Telephone: 703-358-1957
Fax: 703-358-1997

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Michael Gale

Deputy Chief of Staff (Acting), Director's Office
U.S. Fish and Wildlife Service

202.208.4923 (office)
571.982.2158 (cell)

Appendix I

# INTERNATIONAL CONSERVATION AGREEMENT

**Agreement Between the Government of Canada and the Government of the United States of America on the Conservation of the Porcupine Caribou Herd**

Ottawa, July 17, 1987
In force, July 17, 1987

The Government of Canada and the Government of the United States of America, hereinafter called the "Parties":

Recognizing that the Porcupine Caribou Herd regularly migrates across the international border between Canada and the United States of America and that caribou in their large free-roaming herds comprise a unique and irreplaceable natural resource of great value which each generation should maintain and make use of so as to conserve them for future generations;

Acknowledging that there are various human uses of caribou and that for generations certain people of Yukon Territory and the Northwest Territories in Canada have customarily and traditionally harvested Porcupine Caribou to meet their nutritional, cultural and other essential needs and will continue to do so in the future, and that certain rural residents of the State of Alaska in the United States of America have harvested Porcupine Caribou for customary and traditional uses and will continue to do so in the future, and that these people should participate in the conservation of the Porcupine Caribou Herd and its habitat;

Recognizing the importance of conserving the habitat of the Porcupine Caribou herd, including such areas as calving, post-calving, migration, wintering and insect relief habitats;

Understanding that the conservation of the Porcupine Caribou Herd and its habitat requires goodwill among landowners, wildlife managers, users of the caribou and other users of the area;

Recognizing that the Porcupine Caribou Herd should be conserved according to ecological principles and that actions for the conservation of the Porcupine Caribou Herd that result in the long-term detriment of other indigenous species of wild fauna and flora should be avoided;

Recognizing that cooperation and co-ordination under the Agreement should not alter domestic authorities regarding management of the Porcupine Caribou Herd and its habitat and should be implemented by existing rather than new management structures;

Have agreed as follows:

## 1. Definitions

For the purposes of this Agreement only:

a. "Porcupine Caribou Herd" means those migratory barren ground caribou found north of 64 degrees, 30' north latitude and north of the Yukon River which usually share common and traditional calving and post-calving aggregation grounds between the Canning River in the State of Alaska and the Babbage River in Yukon Territory and which historically migrate within the State of Alaska, Yukon Territory, and the Northwest Territories.

b. "Conservation" means the management and use of the Porcupine Caribou Herd and its habitat utilizing methods and procedures which ensures the long term productivity and usefulness of the Porcupine Caribou Herd. Such methods and procedures include, but are not limited to, activities associated with scientific resources management such as research, law enforcement, census taking, habitat maintenance, monitoring and public information and education.

c. "Habitat" means the whole or any part of the ecosystem, including summer, winter, and migration range, used by the Porcupine Caribou Herd during the course of its long term movement patterns, as generally outlined on the map attached as an Annex.

## 2. Objectives

The objectives of the Parties are:

a. To conserve the Porcupine Caribou Herd and its habitat through international cooperation and coordination so that the risk of irreversible damage or long-term adverse effects as a result of use of caribou or their habitat is minimized;

b. To ensure opportunities for customary and traditional uses of the Porcupine Caribou Herd by:

(1) in Alaska, rural Alaska residents in accordance with 16 U.S.C. 3113 and 3114, AS 16.05.940(23), (28) and (32), and AS 16.05.258(c); and

(2) in Yukon and Northwest Territories, Native users as defined by sections A8 and A9 of the Porcupine Caribou Management Agreement (signed on October 26, 1985) and those other users identified pursuant to the process described in section E2(e) of the said Agreement;

c. To enable users of Porcupine Caribou to participate in the international co-ordination of the conservation of the Porcupine Caribou Herd and its habitat;

d. To encourage cooperation and communication among governments, users of Porcupine Caribou and others to achieve these objectives.

**3. Conservation**

a. The Parties will take appropriate action to conserve the Porcupine Caribou Herd and its habitat.

b. The Parties will ensure that the Porcupine Caribou Herd, its habitat and the interests of users of Porcupine Caribou are given effective consideration in evaluating proposed activities within the range of the Herd.

c. Activities requiring a Party's approval having a potential impact on the conservation of the Porcupine Caribou Herd or its habitat will be subject to impact assessment and review consistent with domestic laws, regulations and processes.

d. Where an activity in one country is determined to be likely to cause significant long-term adverse impact on the Porcupine Caribou Herd or its habitat, the other Party will be notified and given an opportunity to consult prior to final decision.

e. Activities requiring a Party's approval having a potential significant impact on the conservation or use of the Porcupine Caribou Herd or its habitat may require mitigation.

f. The Parties should avoid or minimize activities that would significantly disrupt migration or other important behavior patterns of the Porcupine Caribou Herd or that would otherwise lessen the ability of users of Porcupine Caribou to use the Herd.

g. When evaluating the environmental consequences of a proposed activity, the Parties will consider and analyze potential impacts, including cumulative impacts, to the Porcupine Caribou Herd, its habitat and affected users of Porcupine Caribou.

h. The Parties will prohibit the commercial sale of meat from the Porcupine Caribou Herd.

**4. International Porcupine Caribou Board**

a. The Parties will establish an advisory Board to be known as the International Porcupine Caribou Board, hereinafter called the Board.

b. The Parties will each appoint four members of the Board within a reasonable period following the entry in force of the present Agreement.

c. The Board will:

(1) adopt rules and procedures for its operation, including those related to the chairmanship of the Board; and

(2) give advise or make recommendations to the Parties, subject to concurrence by a majority of each party's appointees.

d. The Board, seeking, where appropriate, information available from management agencies, local communities, users of Porcupine Caribou, scientific and other interests, will make recommendations and provide advice on those aspects of the conservation of the Porcupine Caribou Herd and its habitat that require international co-ordination, including but not limited to the following:

(1) the sharing of information and consideration of actions to further the objectives of this Agreement at the international level;

(2) the actions that are necessary or advisable to conserve the Porcupine Caribou Herd and its habitat;

(3) cooperative conservation planning for the Porcupine Caribou Herd throughout its range;

(4) when advisable to conserve the Porcupine Caribou Herd, recommendations on overall harvest and appropriate harvest limits for each of Canada and the United States of America taking into account the Board's review of available data, patterns of customary and traditional users and other factors the Board deems appropriate;

(5) the identification of sensitive habitat deserving special consideration; and

(6) recommendations, where necessary, through the Parties as required, to other boards and agencies in Canada and the United States of America on matters affecting the Porcupine Caribou Herd or its habitat.

e. It is understood that advise and recommendations of the Board are not binding on the Parties; however, by virtue of this Agreement, it has been accepted that the parties will support and participate in the operation of the Board. In particular they will:

(1) provide the Board with the information regarding the conservation and use of the Porcupine Caribou Herd and its habitat;

(2) promptly notify the Board of proposed activities that could significantly affect the conservation of the Porcupine Caribou Herd or its habitat and provide an opportunity to the Board to make recommendations;

(3) consider the advice and respond to the recommendations of the Board; and

(4) provide written reasons for the rejection in whole or in part of conservation recommendations made by the Board..

**5. International Responsibility**

The Parties will consult promptly to consider appropriate action in the event of:

a. significant damage to the Porcupine Caribou Herd or its habitat for which there is responsibility, if any, under international law; or

b. significant disruption of migration or other important behavior patterns of the Porcupine Caribou Herd that would significantly lessen the ability of users of Porcupine Caribou to use the Herd.

**6. Implementation**

Cooperation and co-ordination under and other implementation of this Agreement shall be consistent with the laws, regulations and other national policies of the Parties and is subject to the availability of funding.

**7. Interpretation and Application**

All questions related to the interpretation or application of the Agreement will be settled by consultation between the Parties.

**8. Entry into force; Amendments**

a. This agreement which is authentic in English and French shall enter into force on signature and shall remain in force until terminated by either Party upon twelve month's written notice to the other.

b. At the request of either Party, consultations will be held with a view to convening a meeting of the representatives of the Parties to amend the Agreement.

IN WITNESS WHEREOF, the undersigned, being duly authorized by their respective Governments, have signed this Agreement.

DONE at Ottawa, in duplicate, this Seventeenth day of July, 1987 in the English and French languages, both texts being equally authentic.

(signed by John McMillan)

FOR THE GOVERNMENT
OF CANADA

(signed by Donald Paul Hodel)

FOR THE GOVERNMENT OF THE
UNITED STATES OF AMERICA

# INFORMATION MEMORANDUM

**Date:** October 26, 2017
**From:** Greg Sheehan, Principal Deputy Director, U.S. Fish & Wildlife Service
**Subject:** Arctic National Wildlife Refuge and International Porcupine Caribou Board

Below is an update on oil and gas drilling issues on the Arctic National Wildlife Refuge and background information on the International Porcupine Caribou Board. This is an issue that has generated interest from Canada.

## BACKGROUND

On October 19, 2017, the U.S. Senate passed a budget resolution that could provide Alaska's congressional delegation with the opportunity to open part of the Arctic National Wildlife Refuge (Arctic Refuge) to oil and gas drilling. Canada has expressed concern that the U.S. is not fulfilling obligations under an agreement from 1987 to notify and consult with Canada on any proposed changes that could impact the Porcupine Caribou Herd that seasonally migrates to the area being considered for exploration. The U.S. and Canada jointly chair an International Porcupine Caribou Board, which meets twice a year. The Board has not met since December 2016 due to internal review of all Boards at the Department of the Interior at the Secretary's level.

## DISCUSSION

Arctic Refuge was established in 1960 to preserve and protect its unique wilderness, abundant wildlife, and recreational value as post-WWII construction and resource development raised concerns about environmental losses. With the passage of the 1980 Alaska National Interest Lands Conservation Act (ANILCA), the size of the refuge doubled, deeming most of the original range as "wilderness." All areas not allocated as "wilderness" became the "1002 Area," named after Section 1002 of ANILCA, which describes the specific data Congress would need before it could designate the area as "wilderness" or permit oil development.

The International Porcupine Caribou Board (IPCB) was established through signing of the July 17, 1987 International Conservation Agreement by representatives of the governments of Canada and the United States. The purpose of the IPCB is to conserve the herd and its habitat through international cooperation and to ensure continued opportunities for traditional uses by local Arctic residents. The porcupine caribous migrate each year from Canada and come to the coastal plains of the 1002 area for calving annually in late May. Due to the high numbers of caribou that come to this area, it has been regarded as a concentrated calving zone.

The Porcupine Caribou Herd is the largest herd of migratory mammals shared between the U.S. and Canada. The IPCB is charged with making recommendations and providing advice on those aspects of the conservation of the Porcupine Caribou Herd and its habitat that require international coordination so the risk of long-term adverse effects on caribou or their habitat is minimized. The Agreement has stimulated significant cooperation between the two countries,

including shared research, monitoring, and management activities in the State of Alaska and Yukon Territory.

Each country is responsible for appointing four members on the IPCB. Both countries made their first appointments to the IPCB in 1988. The IPCB is co-chaired by a member of the U.S. Fish and Wildlife Service (FWS) and Canadian Wildlife Service. In the recent past, other U.S. IPCB members have been from the Alaska Department of Fish and Game, and G'wichin and Inupiat representatives who are leaders from their villages who wish to continue the hunting heritage of their peoples. The Board was active from 1989 to 2000, and again starting in 2011. The last face-to-face meeting for the IPCB was held November 30 and December 1, 2016, in Fairbanks, Alaska, and Venetie, Alaska. The next meetings will be hosted by Canada and have not been scheduled due to a larger review of all boards and commissions within the Department.

Conservation of the porcupine caribou herd and providing the opportunity for continued subsistence uses by local residents are two of the purposes for which the Arctic Refuge was established under ANILCA. In 2015, the FWS updated the Revised Arctic Refuge Comprehensive Conservation Plan (CCP), the document that guides Refuge management activities. The CCP reiterates the Refuge's goals of protection for the Porcupine Caribou Herd and its habitat throughout the Refuge.

The international conservation community is keenly interested in all issues related to the Porcupine Caribou Herd. The Canadian Wildlife Service and Governments of Yukon and Northwest Territories have a significant interest in the health of the Porcupine Caribou Herd in order to ensure customary and traditional uses continue. The herd is also depended on by certain rural residents in Alaska for customary and traditional purposes.

**TALKING POINTS**

- The Department of the Interior is currently reviewing the rule that would provide for geophysical exploration in the Arctic Refuge.

- We do not have further information at this time.

**ATTACHMENTS**

Agreement between the U.S. and Canada on the International Porcupine Caribou Board.

| | |
|---|---|
| **From:** | Matuskowitz, Theo |
| **To:** | Clark, Karen |
| **Cc:** | Boario, Sara; Gene Peltola; Doolittle, Thomas; Jennifer Hardin; Caron Mckee; Kayla Mckinney |
| **Subject:** | Re: Due by NOON Thursday, November 16, 2017: Weekly 30-day Projection Report for Federal Register Documents |
| **Date:** | Tuesday, November 14, 2017 2:04:06 PM |
| **Attachments:** | Subsistence, 30 day spreadsheet 14 Nov 2017.xlsx |

---

Updates from OSM. This has already been sent to Annissa at PPM.

Thanks,
Theo

On Mon, Nov 13, 2017 at 8:32 AM, Clark, Karen <karen_clark@fws.gov> wrote:

> Hi Everyone, Seems we receive these on a weekly basis now. I will keep sending to ensure we are all on the same page. Thanks for keeping us up to date with HQ :)
>
> Karen
>
> Karen P. Clark
> Deputy Regional Director
> U.S. Fish & Wildlife Service- Alaska Region
> 1011 E Tudor Rd, MS 374
> Anchorage, AK 99503
> karen_clark@fws.gov
> 907.786.3542 office
> 907.786.3493 direct
> 907.786.3306 fax
>
> ---------- Forwarded message ----------
> From: **Craghead, Anissa** <anissa_craghead@fws.gov>
> Date: Mon, Nov 13, 2017 at 7:55 AM
> Subject: Due by NOON Thursday, November 16, 2017: Weekly 30-day Projection Report for Federal Register Documents
> To: Shaun Sanchez <shaun_sanchez@fws.gov>, Jeffery Donahoe <jeffery_donahoe@fws.gov>, "Miller, Kayla" <kayla_miller@fws.gov>, Eric Kershner <eric_kershner@fws.gov>, Ronald Kokel <ronald_kokel@fws.gov>, Gloria Bell <gloria_bell@fws.gov>, Craig Hoover <craig_hoover@fws.gov>, Rosemarie Gnam <rosemarie_gnam@fws.gov>, Tim Vannorman <tim_vannorman@fws.gov>, Robert Curry <robert_curry@fws.gov>, Tom Busiahn <tom_busiahn@fws.gov>, Edward Grace <edward_grace@fws.gov>, Karen Clark <karen_clark@fws.gov>, Madonna Baucum <madonna_baucum@fws.gov>, Theresa Rabot <theresa_rabot@fws.gov>, Joy Nicholopoulos <joy_nicholopoulos@fws.gov>, Charles Wooley <charles_wooley@fws.gov>, Michael Oetker <michael_oetker@fws.gov>, "Eustis, Christine" <christine_eustis@fws.gov>, Matt Hogan <matt_hogan@fws.gov>, Alexandra Pitts <alexandra_pitts@fws.gov>, Aaron Mize <aaron_mize@fws.gov>, John Schmerfeld <john_schmerfeld@fws.gov>, "Van Alstyne, Lisa" <lisa_van_alstyne@fws.gov>, Julie Jackson <julie_jackson@fws.gov>, "Cogliano, Mary" <mary_cogliano@fws.gov>, Gary Frazer <gary_frazer@fws.gov>, Gina Shultz <Gina_Shultz@fws.gov>, Jeff Newman

<jeff_newman@fws.gov>, Bridget Fahey <bridget_fahey@fws.gov>, Craig Aubrey <craig_aubrey@fws.gov>
Cc: Sara Prigan <sara_prigan@fws.gov>, Susan Wilkinson <susan_wilkinson@fws.gov>, Katherine Garrity <katherine_garrity@fws.gov>, "Unbehaun, Nancy" <nancy_unbehaun@fws.gov>

Hi, all---

Please submit your input for the weekly report of **all** Federal Register (FR) documents (both notices and rules) estimated to clear the Department in the next 30 days.

**IMPORTANT INFORMATION:**

**Timelines for This Report**
Please use the attached to submit any updates and additions by NOON **on Thursday, November 16**. When updating the attached spreadsheet, please pay special attention to "Summary," "Estimated Date for DOI Clearance," "Current Status," and
"Has Been at Current Status Since (Date)" responses for your actions. When updating entries, please be aware that this report
generally covers late November to late December time frames. Please highlight the cells that you change so that it will be easier for us to identify your changes. Your input should be emailed to Anissa Craghead, Sara Prigan, and Susan Wilkinson.

**This week's report should list only those FR documents estimated to clear the Department between November 21 and
December 21, 2017.**

**Other Information**
In order to ensure that we don't provide conflicting information during the clearance process, please:
--provide us complete and accurate information for this 30-day projection;
--update briefing papers to include any new dates (and, if applicable, information) UNLESS you've identified a "not later than" (NTL)
date that carries notable consequences---such NTL dates should be retained and explained in your briefing paper; and
--upload revised briefing papers into DTS.
DTS entries for your actions **must** include the most up-to-date information.

Exec Sec continues to urge us to be realistic in terms of the documents we put on this list. If the document has not been provided to
our Director's corridor for surnaming, it probably should not be on the list considering how long surnaming/clearance is taking at each
step of the process.

Please note that Kayla Miller, Special Assistant, Ecological Services in Headquarters is providing the input for both Headquarters and
Regional ES documents.

Additionally, PPM will provide updates for all Information Collection notices.

If you have any questions, please contact me at anissa_craghead@fws.gov.

Thanks once again for your help with this.

> Anissa
>
> *Anissa Craghead*
> *Senior Management Analyst, Division of Policy, Performance, and Management Programs*
> *U.S. Fish and Wildlife Service*
> *5275 Leesburg Pike, MS: BPHC*
> *Falls Church, VA 22041-3803*
>
> *Telephone: 703-358-2445*

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*Theo Matuskowitz*
*Regulations Specialist*
*US Fish and Wildlife Service*
*Office of Subsistence Management*
*1011 East Tudor Road, MS 121*
*Anchorage, AK 99503-6199*
*(907) 786-3867*
*FAX (907) 786-3898*

| Bureau | RIN or OMB Control Number | Title | Summary | Type | Estimated Date for DOI Clearance | Critical Date (Judicial, Statutory, or Other) | Current Status | Has Been at Current Status Since (Date) | DCN (Optional) | Program (Optional) | Explain Critical Date if "Other" |
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| FWS | 1018-BC92 | Geological and Geophysical Exploration of the Coastal Plain, Arctic National Wildlife Refuge, Alaska; Exploration Plans; Application Requirements | The proposed rule would amend the regulations that restrict the dates when an application may be submitted for a permit for a geological and geophysical exploration plan on the Arctic National Wildlife Refuge lands described in the Alaska National Interest Lands Conservation Act. | Proposed Rule | early November | | | | SEN 6553 | NWRS | |

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| **From:** | Brady, Stephanie |
| **To:** | Brian McCaffery; John Martin; Nicole Gustine; Peter Wikoff; Tracy Fischbach; Hansel Klausner |
| **Subject:** | Fwd: RDT Meeting Notes - November 14th |
| **Date:** | Tuesday, November 14, 2017 3:51:02 PM |
| **Attachments:** | RDTNotes111417.pdf |

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Yeah Brian for making the RDT notes - thanks for all of your work with FES - making planning proud! Stephanie

stephanie_brady@fws.gov | Branch Chief, Conservation Planning and Policy |
U.S. Fish and Wildlife Service | National Wildlife Refuge System | Alaska |
907.306.7448

---------- Forwarded message ----------
From: **Davis, Tauline** <tauline_davis@fws.gov>
Date: Tue, Nov 14, 2017 at 1:09 PM
Subject: RDT Meeting Notes - November 14th
To: FW7 All Users-dynamic <fw7allusers-dynamic@fws.gov>

Attached are the RDT Meeting notes for the week, as reported and submitted by the Programs. Have a great week!

--
Tauline Davis
907-786-3542
Executive Assistant
Regional Director's Office

**For Internal Use – Not for Further Distribution**

**U.S. Fish and Wildlife Service - Region 7**

**Regional Directorate Team Announcements 11-13-17**

**"News You Can Use" – As Provided by Each RDT Member**

*For more in-depth news from the RDT on face-to-face visits and program highlights, please visit our message board https://fishnet.fws.doi.net/regions/7/RD/rdtblog/default.aspx*
*& please visit the Region 7 Fishnet - Site (link is below)*
*https://fishnet.fws.doi.net/regions/7/*

## Regional Director's Office (Karen Clark, and Tauline Davis)

- Greg is out of the office through Wednesday attending the Wildlife and Sport Fish Restoration Joint Federal-State Task Force on Federal Assistance Policy Meeting, Karen Clark is Acting RD
- Karen attended the Sea Grant Advisory meeting last week. Thanks to Aaron Poe and Karen Murphy for their support in preparation
- Thanks to Mitch Ellis and Carol Damberg for attending and representing the Service at the Board of Game meeting on Friday

### Tauline Davis (Executive Assistant)

- The next Open RDT Meeting is Monday, November 20th at 9:00 a.m. in the OSM CR. Can't join us in Anchorage? Then join us by teleconference as follows: Dial b5-CIP enter participant code: b5-CIP
- There will be a Blood Drive at the RO on December 6th, Tauline will be emailing out the event participation details this week
- Tauline is out of the office on leave next week. Lynne will be Acting RD Assistant - November 20 - 22nd, and Lucille Frerich will be Acting RD Assistant on Friday, November 24th

## Diversity & Civil Rights (Tonyua Robinson)

Terry Whittaker will teach a Civil Treatment for Leaders class in Homer on November 15th, 12:00 - 4:30 p.m.

## Conservation of Arctic Flora and Fauna (CAFF) Chair

- Cindi will chair a CAFF Board inter-sessional meeting tomorrow. The topics include progress on achieving priorities for the Arctic Migratory Bird Initiative (AMBI), including hiring AMBI coordinators in three flyways; hosting an AMBI workshop in China in 2018; and finalizing revisions to the AMBI work plan.
- Cindi is working on drafting an agenda for the February 5th meeting of the CAFF AK Partners Group. This will be an interactive meeting, so at next week's RDT meeting, Cindi will ask the RDT for feedback on specific agenda items.
- Cindi is meeting with Institute of the North to continue planning for the February CAFF Board meeting in Fairbanks.

## Assistant Regional Director - Budget and Administration (Doug Mills)

- Reminder: Please remind staff to only allow known individuals building access. Recently an unauthorized person was encountered in the building. When asked how they got in the building, they said they gained access from a building employee. Allowing unauthorized access could potentially place yourself (or others) at risk

*Budget & Finance*

- We are in the final stages of the General Operations and Common Services Budget development. We will distribute it for RDT review this week

*Contracting and General Services*

- **DOI-OS Review of Awards >100k Update -** October and November award packages are currently under review. On average, the review process has taken between 4-6 weeks. Please continue to list awards for review on our Google sheet as soon as you have the required information
    - Moving forward, the deadline to list an award on the Google sheet for the next month's review package will be the 3rd Monday of the month:
        - December package - COB Monday, Nov 20th
        - January package - COB Monday, Dec 18th
        - February package - COB Monday, January 15th

**Assistant Regional Director - External Affairs (Crystal Leonetti, Acting)**

- Sara is out Monday, back in the office on Tuesday.
- For Veterans Day, we highlighted several 75th Anniversary stories about the Battle of Attu. See our website, Facebook, and Twitter for those stories. Thank you Maritime Refuge and all who worked on the events. Thank you to Region 7 Veterans for your service!
- ABC news is planning to air a story about Polar Bears in Kaktovik on Wednesday, November 15th on Good Morning America and Nightline. Thanks to Polar Bear lead biologist Jim Wilder and Refuge Supervisor Doug Damberg for being interviewed. Thanks to all who helped on this story!
- The retired USFWS airplane N754 is now on display in the Anchorage airport! Media event and more stories coming soon.
- The next Alaska Native Relations training will incorporate all DOI agencies and is scheduled for January 29 – February 2nd in Anchorage. Sign up will be coming out this week. Project Leaders and Supervisors, if you have not yet taken this training, please sign up; and also encourage staff who haven't taken it to sign up.
- Thank you to everyone who assisted with Questions for the Record (QFRs) resulting from the November 2nd, Arctic Refuge Hearing. We received a variety of questions from Senators Cantwell, Wyden, and Sanders.
- Thank you Migratory Bird Program and Refuges for your assistance in responding to Senator Murkowski's staff questions about migratory birds that were forwarded to us by HQ. It was a quick turn around and your efforts are most appreciated!
- On Wednesday, November 8th, the House Natural Resource hearing and markup on legislation H.R. 4239 the SECURE American Energy Act. The committee voted 19-14 to pass the legislation. The bill will now go to the House floor for a vote. There are potential impacts to the Marine Mammals Protection Act and the Migratory Bird Treaty Act if passed into law.

- On Friday, November 9th, Senator Murkowski provided legislation to be included in the tax reform bill regarding oil and gas development in the coastal plain of the Arctic Refuge. The legislation is scheduled for markup this week on Wednesday, November 15th.
- Amee will be updating our Congressional highlights handout, and will be in touch with program contacts to make any updates.
- Letters to Tribal Leaders are no longer required to go to Headquarters for approval prior to sending.

**Office of Law Enforcement (OLE)** b7C

- b5-DP (and not responsive) No detail to provide at this time. More to follow.
- b7C are in the office this week.

**Migratory Birds (Eric Taylor)**

- MBM met on Monday and Tuesday to discuss programmatic, regional and national topics. b5-DP (and not responsive)
- The Service's DeHavilland Beaver N754 was installed in the Ted Stevens Anchorage International Airport. MBM received funding from the National Aviation Manager to develop a public outreach kiosk highlight the history, surveys, roles, geographic landscapes, and people involved in the design and operation of this aircraft
- Eric is preparing for the Sea Duck Joint Venture Management Board meeting on Thursday, November 16, 2017 in LaConner, Washington
- Eric Taylor will be drafting the spring/summer migratory bird subsistence harvest section for the MBM National Strategic Plan.
- Eric Taylor will meet with Contracting and General Services b5-DP (and not responsive)
- Eric will be on annual leave from Friday, November 17th through Friday, December 1st
- Paul Matusewic notified the Division that nominations for March 2018 conference attendees are due November 17, 2017
- Tim Bowman is leading the Sea Duck Joint Venture meetings from November 14-17, 2017
- Rick Lanctot is attending the Western Hemisphere Shorebird Group meeting from November 12-14 in Peru and then traveling to Argentina on November 15th to capture and equip Buff-breasted Sandpipers with GPS and PTT tags the rest of the week
- b5-DP (and not responsive)
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- Robb Kaler, Kathy Kuletz, and Liz Labunski will be attending the annual Gulf Watch Alaska Pls meeting in Cordova from November 14-17, 2017
- Julian Fischer will participate in a Yukon-Kuskokwim Delta biological meeting with YDNWR, FES, and USGS personnel
- David Safine is at the Sea Duck Joint Venture Continental Technical Team meeting in LaConner, Washington

**Wildlife and Sport Fish Restoration (WSFR) - (Steve Klein)**

- Steve attended a WSFR Funding Needs Analysis Workshop with Regional WSFR Chiefs and our consultant, PriceWaterhouse Coopers. b5-DP (and not responsive)
  The BIG Program provides grants to states to construct and maintain tie-up facilities for transient boaters 26 feet or more in length
- Doug and Tj met with Brenda Bowers and Jeff Hoover from ADF&G's Wildlife Conservation Division b5-DP (and not responsive)

**National Wildlife Refuge System (Doug Damberg, Acting)**

- Mitch Ellis is beginning his detail this week as the Acting Chief, Division of Natural Resources and Conservation Planning in Headquarter. Soch Lor is attending LE for Supervisors training at NCTC this week. Doug Damberg will be acting ARD this week.
- Ryan Mollnow is attending the introductory kickoff meeting for the Regional Hunting and Fishing Chiefs in headquarters this week.
- Wage Grade academy nominations are due the first week of December for the March 26 to 30, 2018 session at NCTC. Each Region has been allocated three slots. A formal request will be sent out to field stations this week.
- Selawik NWR staff, in cooperation with National Park Service staff, will be hosting an open house for the Kotzebue community on November 15 in celebration of Native American/Alaska Native Heritage month.
- Reminder that the annual National Wildlife Refuge Association award nominations are due on November 15th.
- The Combined Federal Campaign kickoff event will be held Tuesday, November 14th in the Gordon Watson conference room. Special thanks to Ronnie Sanchez and Toni Romero for co-chairing the event on behalf of the Refuge program this year.

**Office of Subsistence Management (Gene Peltola, Jr.)**

- Wildlife Special Action WSA 17-05 public hearing held in Tok and available via teleconference on November 7th, was fairly well attended
- Eastern Interior Regional Advisory Council voted on November 9th to support Wildlife Special Action WSA 17-05
- Finalizing FSB January Work-session Agenda
- Ninilchik Traditional Council litigation was dismissed on November 6th, based on settlement agreement
- Gene will be in attendance at the upcoming North Slope Subsistence Regional Advisory Council Meeting will be held November 15-17 at the Inupiat Heritage Center, in Utiagvik (Barrow). Jennifer Hardin will be Acting for Gene, she is currently Acting Deputy through Thanksgiving
- Alaska Board of Game meetings are being held this week at the Lake Front Hotel in Anchorage. OSM staff, Gene and Federal Subsistence Board Chair Anthony Christianson will be in attendance
- Khristoffer Santos is currently out of state assisting with disaster relief efforts
- Wildlife staff are making edits to wildlife proposals in preparation for the Interagency Staff Committee (ISC2) meeting

**Office of Science Applications (Sarena Selbo)**

- We are presenting at the Alaska Tribal Conference on Environmental Management this week alongside of our Alaska Tribal partners. We will be sharing, 1) our work on the coastal resilience workshops and the new website AdaptAlaska.org hosted by our partners at Alaska Sea Grant and, 2) information about the 15 or so projects that the Western Alaska LCC has supported on the Yukon Delta Descriptions of these projects can be found here
- Aaron Poe's new book, *Sustaining Wildlands: Integrating Science and Community in Prince William Sound* will be released this Thursday--more at www.SustainingWildlands.com
- At the NSSI meeting last week, working groups were formed to address ecosystem monitoring, subsistence species distribution & disturbance and aircraft impacts on hunting. FWS staff interesting in knowing more and possibly sharing their expertise can contact Wendy Loya with Arctic LCC or Mark Miller, NSSI Deputy Director memiller@blm.gov
- The Science Award Nomination Panel met and made preliminary recommendations to present to the RDT next week
- We are working with Alaska Native Tribal Health Consortium, Sea Grant, University of Alaska and Bristol Bay Native Association as part of their Port Heiden Adaptation Planning Process. The LCC staff are engaged to help bring climate and coastal change science into the discussions

**Fisheries & Ecological Services (Mary Colligan)**

- Marine Mammals Management (MMM) participated in a multi-Agency (NOAA – Fisheries, U.S. Coast Guard, State of Alaska, oil and gas industry, and others) spill response drill week.
- This week is a busy week for MMM and co-management meetings. b5-DP (and not responsive)

b5-DP (and not responsive) [redacted]

- On Wednesday and Thursday, 15-16 November, a 2-day co-management board training will take place to help Commissioners that serve on marine mammal co-management boards understand their roles and responsibilities. This meeting is being organized by the Indigenous Peoples Council for Marine Mammals (IPCoMM) with support from NOAA and USFWS.
- On Friday, 17 November, IPCOMM will host its biannual meeting. Patrick Lemons will give an update on MMM activities including the Pacific walrus Endangered Species Act listing decision b5-DP (and not responsive) [redacted].
- Jennie Spegon worked with Melissa Burns and OEPC to finalize our comment letter on the draft Section 4(f) analysis for the Metarvik Community Infrastructure Development Project. It was signed and sent by DOI,11-8-2017. A big thank you goes out to Brian McCaffery, with Refuge Planning for all of his work pulling information together, and many thanks to all who contributed to getting this out.
- Fisheries and Habitat staff attended the Mat-Su Salmon Symposium in Palmer on November 8 and 9.

**Regional Aviation Management (Nate Olson)**

We will be hosting two courses this December and February which are required to become a certified Water Ditching and Survival (A312) instructor.

A223 Water Ditching and Survival Train the Trainer will be offered in Anchorage December 4-8. This course is a pre-requisite to teach A312 courses.

If you have a teaching certificate, Certified Flight Instructor Rating (FAA), or other training and/or credentials to teach this is the only course you will need to become a certified A312 instructor. A waiver is required which is coordinated through myself.

If you do not have the above credentials or a waiver cannot be granted you will also have to take A220 Train the Trainer (general) which will be offered in Anchorage February 26-March 3.

We are limited on the number of A312 courses we can offer in any given year due to a limited pool of instructors. We need more instructors in the Region and you need not be a pilot to instruct this course.

If you are interested in becoming an A312 instructor you can register for these courses at www.iat.gov. If you have questions please contact me.

The minimum expectation for instructors is to instruct 1 A-312 course per year.

**From:** McCaffery, Brian
**To:** Wald, Eric
**Subject:** Timing of caribou in 1002
**Date:** Tuesday, November 14, 2017 3:51:33 PM

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Hey, Eric,

In response to a recent short-term assignment, I need to find out quickly a) the seasonal span of occurrence of caribou in the 1002 (most importantly, how early in the spring can they arrive, by calendar date and/or % snow-cover), and b) any citations (or unattributed comments!) regarding the potential impacts of winter energy exploration on muskox in the 1002. Thanks in advance if you can provide brief insights on either of those two species. Needed ASAP. Sorry for the brief and peremptory nature of this e-mail--DC deadline looming. Thanks--hope you and the family are well!

Cheers,

Brian

--

Brian J. McCaffery
U. S. Fish and Wildlife Service
Natural Resources Planner
National Wildlife Refuge System - Region 7
Division of Natural Resources
Branch of Conservation Planning and Policy

Phone: (907) 330-7514
e-mail: brian_mccaffery@fws.gov

"Do something that scares the living hell outta your boss!" -- Dan Ashe, former Director, USFWS

**From:** Howard, Amee
**To:** annie_hoefler@energy.senate.gov
**Subject:** Arctic Refuge - 1002 acreage question
**Date:** Tuesday, November 14, 2017 4:23:01 PM

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Hi Annie,

I confirmed with our Division of Realty that Kaktovik Inupiat Corporation (KIC) conveyed lands are not included in the 1.57+ million acres measured for the 1002 area.

Let me know if you need anything additional.

Thanks so much!
Amee

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*Amee Howard*
*Congressional and Legislative Affairs*
U.S. Fish & Wildlife Service
Anchorage, Alaska
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https://www.fws.gov/alaska/
"Conservation Begins with Hello"

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| **From:** | Howard, Amee |
| **To:** | Douglas Campbell |
| **Subject:** | Fwd: Murkowski Releases Chairman's Mark to Meet FY2018 Budget Instruction |
| **Date:** | Tuesday, November 14, 2017 4:27:20 PM |
| **Attachments:** | Chairman"s Mark FLO17783 11-15-17 Bus Mtg.pdf<br>Summary of Chairman"s Mark 11-15-17 SENR Cmte Business Meeting.pdf<br>ANWR Map Plate 1 and Plate 2 11-15-17 Bus Mtg.pdf |

Hi Doug,

FYI - here is the legislation that will be marked up tomorrow.

Thanks so much!
Amee

Nov 08 2017

# Murkowski Releases Chairman's Mark to Meet FY2018 Budget Instruction

*Generates Over $1 Billion in Revenues Over First 10 Years to Reduce Federal Deficit*

U.S. Sen. Lisa Murkowski, R-Alaska, today released reconciliation legislation pursuant to the Senate Energy and Natural Resources Committee's instruction to raise $1 billion in federal revenues in H. Con. Res. 71, the Concurrent Resolution on the Budget for Fiscal Year 2018.

"Our instruction is a tremendous opportunity both for our committee and our country," Murkowski said. "The legislation I released tonight will put Alaska and the entire nation on a path toward greater prosperity by creating jobs, keeping energy affordable for families and businesses, generating new wealth, and strengthening our security—while reducing the federal deficit not just by $1 billion over ten years, but tens or even hundreds of billions of dollars over the decades to come."

The reconciliation legislation would authorize limited and responsible energy development in a small part of the non-wilderness portion of the Arctic National Wildlife Refuge in Alaska, known as the "1002 Area" or Coastal Plain.

The Congressional Budget Office estimates the legislation will raise $1.092 billion over the 10-year budget window. Between royalties and federal income taxes, it will raise substantially greater revenues once production from the 1002 Area begins.

View the text of the Chairman's Mark here.

View a summary of the Chairman's Mark here.

View the map referenced in the Chairman's Mark here.

Murkowski is chairman of the Senate Committee on Energy and Natural Resources.

**The committee will hold a markup on the legislation a full week from today, on the morning of Wednesday, November 15**.

Permalink: https://www.energy.senate.gov/public/index.cfm/2017/11/murkowski-releases-chairman-s-mark-to-meet-fy2018-budget-instruction

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"Conservation Begins with Hello"

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"Conservation Begins with Hello"

--
*Amee Howard*
*Congressional and Legislative Affairs*
U.S. Fish & Wildlife Service
Anchorage, Alaska
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"Conservation Begins with Hello"

**SEC. ___. OIL AND GAS PROGRAM.**

(a) DEFINITIONS.—In this section:

(1) COASTAL PLAIN.—The term "Coastal Plain" means the area identified as the 1002 Area on the plates prepared by the United States Geological Survey entitled "ANWR Map – Plate 1" and "ANWR Map – Plate 2", dated October 24, 2017, and on file with the United States Geological Survey and the Office of the Solicitor of the Department of the Interior.

(2) SECRETARY.—The term "Secretary" means the Secretary of the Interior, acting through the Bureau of Land Management.

(b) OIL AND GAS PROGRAM.—

(1) IN GENERAL.—Section 1003 of the Alaska National Interest Lands Conservation Act (16 U.S.C. 3143) is repealed.

(2) ESTABLISHMENT.—

(A) IN GENERAL.—The Secretary shall establish and administer a competitive oil and gas program for the leasing, development, production, and transportation of oil and gas in and from the Coastal Plain.

(B) PURPOSES.—Section 303(2)(B) of the Alaska National Interest Lands Conservation Act (Public Law 96–487; 94 Stat. 2390) is amended—

(i) in clause (iii), by striking "and" at the end;

(ii) in clause (iv), by striking the period at the end and inserting "; and"; and

(iii) by adding at the end the following:

"(v) to provide for an oil and gas program on the Coastal Plain.".

(3) MANAGEMENT.—Except as otherwise provided in this section, the Secretary shall manage the oil and gas program on the Coastal Plain in accordance with the Naval Petroleum Reserves Production Act of 1976 (42 U.S.C. 6501 et seq.) (including regulations).

(4) ROYALTIES.—Notwithstanding the Mineral Leasing Act (30 U.S.C. 181 et seq.), the royalty rate for leases issued pursuant to this section shall be 16.67 percent.

(5) RECEIPTS.—Notwithstanding the Mineral Leasing Act (30 U.S.C. 181 et seq.), of the amount of adjusted bonus, rental, and royalty receipts de-

rived from the oil and gas program and operations on Federal land authorized under this section—

(A) 50 percent shall be paid to the State of Alaska; and

(B) the balance shall be deposited into the Treasury as miscellaneous receipts.

(c) 2 LEASE SALES WITHIN 10 YEARS.—

(1) REQUIREMENT.—

(A) IN GENERAL.—Subject to subparagraph (B), the Secretary shall conduct not fewer than 2 lease sales area-wide under the oil and gas program under this section by not later than 10 years after the date of enactment of this Act.

(B) SALE ACREAGES; SCHEDULE.—

(i) ACREAGES.—The Secretary shall offer for lease under the oil and gas program under this section—

(I) not fewer than 400,000 acres area-wide in each lease sale; and

(II) those areas that have the highest potential for the discovery of hydrocarbons.

(ii) SCHEDULE.—The Secretary shall offer—

(I) the initial lease sale under the oil and gas program under this section not later than 4 years after the date of enactment of this Act; and

(II) a second lease sale under the oil and gas program under this section not later than 7 years after the date of enactment of this Act.

(2) RIGHTS-OF-WAY.—The Secretary shall issue any rights-of-way or easements across the Coastal Plain for the exploration, development, production, or transportation necessary to carry out this section.

(3) SURFACE DEVELOPMENT.—In administering this section, the Secretary shall authorize up to 2,000 surface acres of Federal land on the Coastal Plain to be covered by production and support facilities (including airstrips and any area covered by gravel berms or piers for support of pipelines) during the term of the leases under the oil and gas program under this section.


**Summary of Chairman's Mark**
**Reconciliation Legislation**

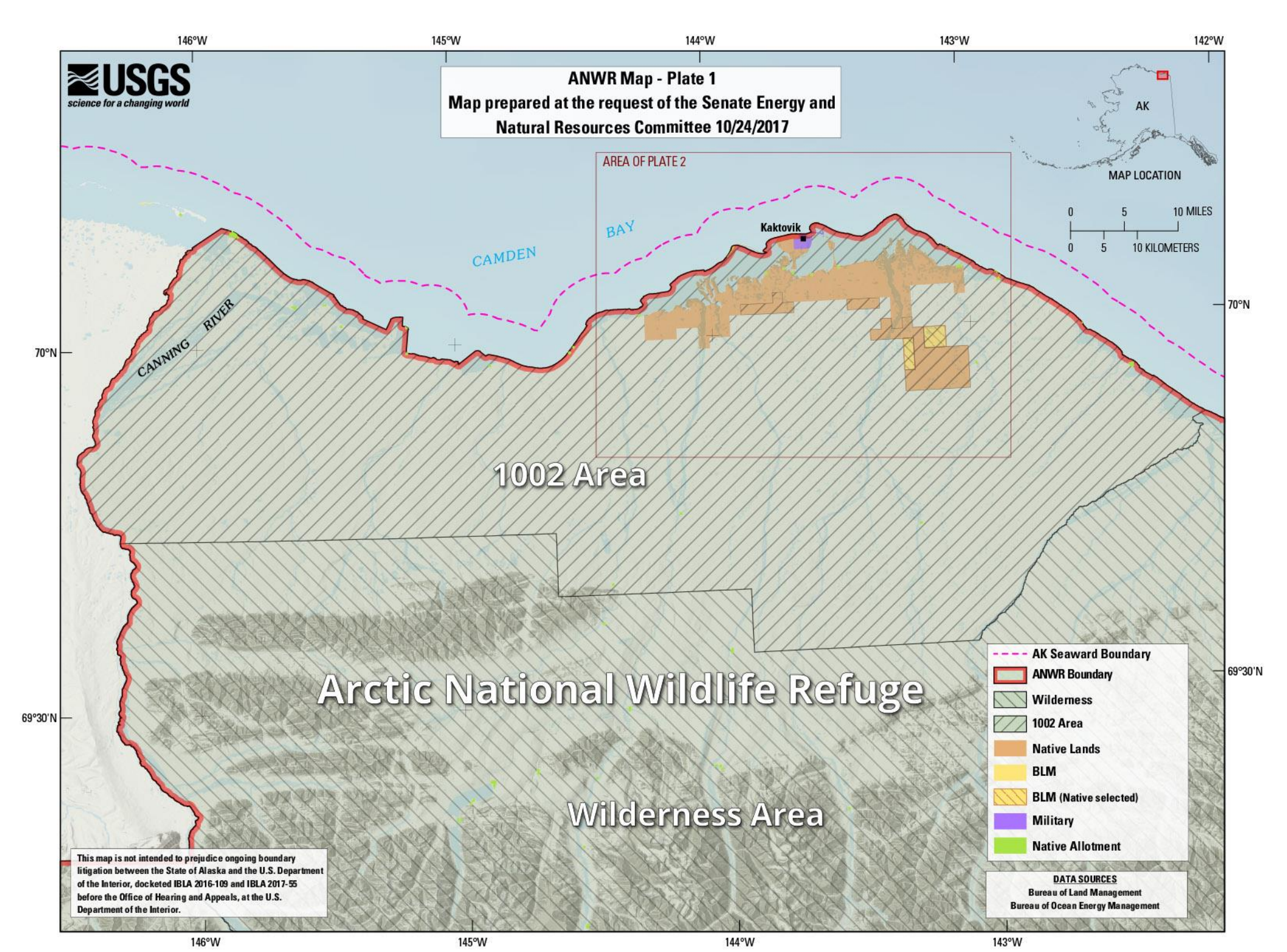
Pursuant to H. Con. Res. 71, the Concurrent Resolution on the Budget for Fiscal Year 2018, the reconciliation legislation contained in the Chairman's Mark directs the Secretary of the Interior to establish and administer a competitive oil and gas program in the non-wilderness portion of the Arctic National Wildlife Refuge, known as the "1002 Area" or Coastal Plain. The legislation defines the term "Coastal Plain" by referencing Plate 1 and Plate 2 of the October 24, 2017 Map prepared by the United States Geological Survey.

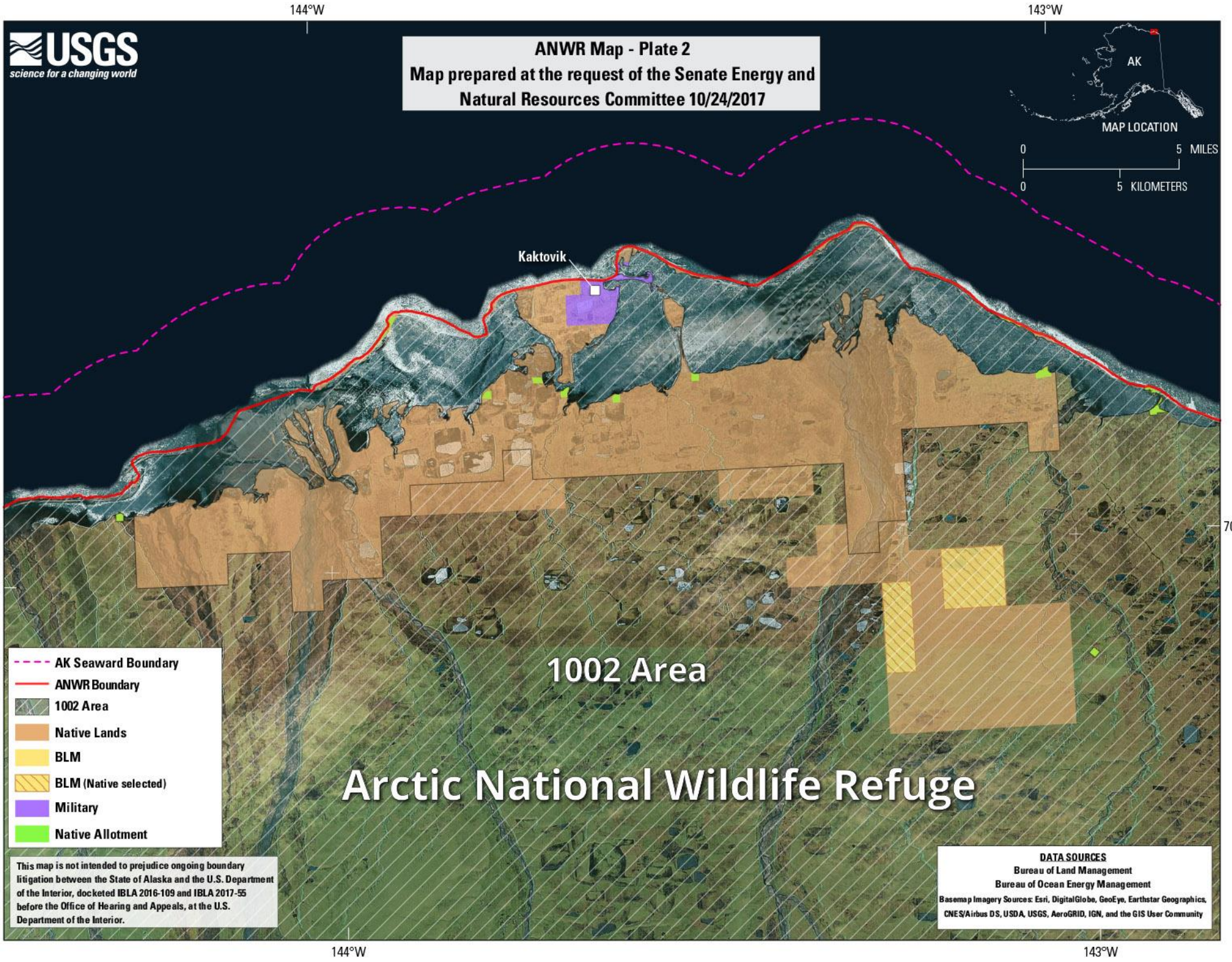
The legislation repeals the prohibition on development from the Coastal Plain contained in section 1003 of the Alaska National Interest Lands Conservation Act (16 U.S.C. 3143), and directs the Secretary to manage the oil and gas program on the Coastal Plain in accordance with the Naval Petroleum Reserves Production Act of 1976 (42 U.S.C. 6501 et seq.), except as otherwise provided. The text imposes a royalty rate for leases at 16.67 percent and allocates 50 percent of the revenue derived from the program to the State of Alaska, with the remainder going to the federal Treasury.

The legislation requires the Secretary to conduct at least two area-wide lease sales within the 10-year budget window. The first lease sale is to be held within four years of the Act's enactment and the second lease sale within seven years of enactment. Each lease sale must contain at least 400,000 acres and be comprised of those areas that have the highest potential for the discovery of hydrocarbons.

The legislation further directs the Secretary to issue any necessary rights-of-way or easements across the Coastal Plain for the exploration, development, production, or transportation associated with the oil and gas program. Additionally, the text limits surface development on federal land on the Coastal Plain to 2,000 acres.

The Congressional Budget Office estimates this reconciliation legislation will raise $1.092 billion over the 10-year budget window.


USGS
science for a changing world
ANWR Map - Plate 1
Map prepared at the request of the Senate Energy and Natural Resources Committee 10/24/2017
AREA OF PLATE 2
AK
MAP LOCATION
0 5 10 MILES
0 5 10 KILOMETERS
Kaktovik
BAY
CAMDEN
CANNING RIVER
1002 Area
Arctic National Wildlife Refuge
Wilderness Area
146°W
145°W
144°W
143°W
142°W
70°N
69°30'N
AK Seaward Boundary
ANWR Boundary
Wilderness
1002 Area
Native Lands
BLM
BLM (Native selected)
Military
Native Allotment
DATA SOURCES
Bureau of Land Management
Bureau of Ocean Energy Management
This map is not intended to prejudice ongoing boundary litigation between the State of Alaska and the U.S. Department of the Interior, docketed IBLA 2016-109 and IBLA 2017-55 before the Office of Hearing and Appeals, at the U.S. Department of the Interior.


USGS
science for a changing world
ANWR Map - Plate 2
Map prepared at the request of the Senate Energy and Natural Resources Committee 10/24/2017
144°W
143°W
AK
MAP LOCATION
0
5 MILES
0
5 KILOMETERS
Kaktovik
70°N
70°N
1002 Area
Arctic National Wildlife Refuge
AK Seaward Boundary
ANWR Boundary
1002 Area
Native Lands
BLM
BLM (Native selected)
Military
Native Allotment
This map is not intended to prejudice ongoing boundary litigation between the State of Alaska and the U.S. Department of the Interior, docketed IBLA 2016-109 and IBLA 2017-55 before the Office of Hearing and Appeals, at the U.S. Department of the Interior.
DATA SOURCES
Bureau of Land Management
Bureau of Ocean Energy Management
Basemap Imagery Sources: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
144°W
143°W

| | |
|---|---|
| **From:** | Putnam, Christopher |
| **To:** | Fischbach, Tracy |
| **Cc:** | Wendy Loya; Ryan Wilson; Joanna Fox; Stephen Arthur; Brian McCaffery; Margaret Perdue; John Trawicki; Edward Decleva; Doug Damberg; Kohout, Jenifer; Steve Berendzen; Karen Clark; Greg Siekaniec; Stephanie Brady; Socheata Lor |
| **Subject:** | Re: Review of Regs at 50 CFR 37.32 & Deadline has moved to Thursday at 10 am |
| **Date:** | Tuesday, November 14, 2017 4:43:15 PM |

Tracy,

I haven't read this regulation before, but I see the inconsistency in 50 CFR 37.32(c) with our oil and gas industry regulations regarding brown bear and polar bear denning special areas. We now have over 20 years worth of experience on how oil and gas industry activities on the north slope affect polar bears. The State of Alaska currently requires a 1/2 mile activity exclusion zone around brown bear dens and we currently require a 1 mile exclusion zone around polar bear dens. Without getting down into the weeds, there is a lot more to this issue than a simple activity exclusion zone. For terrestrial seismic survey activities in proximity to polar bear dens the activity exclusion zone should be 1 mile. Let me know if you have any questions.

Christopher Putnam
Supervisory Fish and Wildlife Biologist
Marine Mammals Management
U.S. Fish & Wildlife Service
1011 East Tudor Rd, MS 341
Anchorage, AK 99503-6199
907-786-3844 office
907-268-0577 mobile
907-786-3816 fax

"All that is gold does not glitter, not all those who wander are lost; the old that is strong does not wither, deep roots are not reached by the frost."
-- J.R.R. Tolkien

On Tue, Nov 14, 2017 at 2:23 PM, Fischbach, Tracy <tracy_fischbach@fws.gov> wrote:

> Hi all,
>
> I am re-reading later sections of Chapter 37 and am looking at 50 CFR 37.32 Special Areas.
>
> Are these still appropriate? SOL asked us to consider whether we need to change these regulations as well. I know we are on a tight deadline, but we need to do a quick gut check to determine whether we need to push forward suggested edits to this section. For instance, I know that we now use a 1 mile buffer for polar bear dens, not 1/2 mile.
>
> **Finally, the deadline has been moved UP.** We now need the draft to Greg and Karen by 2:30 pm on Thursday. **So.... if you can get something to me by 10 am on Thursday, that would be great! Sorry!**
>
> Thanks all,
> Tracy

Tracyann S Fischbach
Natural Resources Planner
National Wildlife Refuge System - Region 7
Division of Natural Resources & Conservation Planning
(907) 786-3369

Hours: Mon - Thurs 9:15 am to 3:15 pm
"Getting right down and smelling the fresh soil is good for any one." - from the 1913 Handbook for Girl Scouts by W. J. Hoxie

**Need access to Refuge Documents?**
Online Document Database (ServCat)
***Need Refuge land status info for Alaska?***
FWS Region 7 Land Mapper (FWS version)
FWS Region 7 Land Mapper (Public version)
Region 7 GeoPDF Map Portal

**From:** Howard, Amee
**To:** Douglas Campbell
**Subject:** Fwd: Arctic Refuge - 1002 acreage question
**Date:** Tuesday, November 14, 2017 4:56:22 PM

---

Hi Doug,

Annie had a clarifying question. Can you take a look and let me know?

Thanks so much!
Amee

---------- Forwarded message ----------
From: **Hoefler, Annie (Energy)** <Annie_Hoefler@energy.senate.gov>
Date: Tue, Nov 14, 2017 at 2:43 PM
Subject: RE: Arctic Refuge - 1002 acreage question
To: "Howard, Amee" <amee_howard@fws.gov>

Thank you! I assume that the fourth township (post ANILCA) is included in the 1.57 figure?

**From:** Howard, Amee [mailto:amee_howard@fws.gov]
**Sent:** Tuesday, November 14, 2017 6:23 PM
**To:** Hoefler, Annie (Energy) <Annie_Hoefler@energy.senate.gov>
**Subject:** Arctic Refuge - 1002 acreage question

Hi Annie,

I confirmed with our Division of Realty that Kaktovik Inupiat Corporation (KIC) conveyed lands are not included in the 1.57+ million acres measured for the 1002 area.

Let me know if you need anything additional.

Thanks so much!

Amee

--

*Amee Howard*

*Congressional and Legislative Affairs*

U.S. Fish & Wildlife Service

Anchorage, Alaska

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Mobile: (907)229-8575

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**From:** Howard, Amee
**To:** Hoefler, Annie (Energy)
**Subject:** Re: Arctic Refuge - 1002 acreage question
**Date:** Tuesday, November 14, 2017 5:34:01 PM

---

Hi Annie,

That is my understanding, but I will confirm with our Chief of Realty in the morning and get back to you ASAP.

Have a fantastic evening!
Amee

On Tue, Nov 14, 2017 at 2:43 PM, Hoefler, Annie (Energy) <Annie_Hoefler@energy.senate.gov> wrote:

> Thank you! I assume that the fourth township (post ANILCA) is included in the 1.57 figure?
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> **From:** Howard, Amee [mailto:amee_howard@fws.gov]
> **Sent:** Tuesday, November 14, 2017 6:23 PM
> **To:** Hoefler, Annie (Energy) <Annie_Hoefler@energy.senate.gov>
> **Subject:** Arctic Refuge - 1002 acreage question
>
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>
> I confirmed with our Division of Realty that Kaktovik Inupiat Corporation (KIC) conveyed lands are not included in the 1.57+ million acres measured for the 1002 area.
>
> Let me know if you need anything additional.
>
> Thanks so much!
>
> Amee
>
> --
>
> *Amee Howard*
>
> *Congressional and Legislative Affairs*

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**From:** Howard, Amee
**To:** Amee R. Howard
**Subject:** Fourth Township
**Date:** Tuesday, November 14, 2017 5:38:10 PM

---

Also under ANILCA, KIC was entitled to select a fourth township, for a total of approximately 92,000 acres. This township is within the area administratively defined as the Coastal Plain.

A description of the Coastal Plain was published that excluded the approximately three townships of KIC lands then in existence, even though these lands are *geographically* part of the coastal plain and totaled approximately 69,000 acres. (48 Fed.Reg. 1685, April 19, 1983; Appendix I, 50 C.F.R. Part 37.)

These lands and a later-selected fourth KIC township that is within the defined Coastal Plain[3] (these four total approximately 92,000 acres) are all within the Refuge and subject to its regulations.

--

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**From:** Steve Kendall
**To:** David Payer; Christopher Latty
**Subject:** RE: CCP question for you
**Date:** Tuesday, November 14, 2017 5:54:50 PM
**Attachments:** Main Refuge Bird list.xls

---

Hi Chris,

I pulled that information from a spreadsheet where I tracked observations (attached) reported to me, from literature and from daily bird observation lists kept in field camps. This is what I used to make the Refuge bird list.

I'm not sure if that addresses the question of vetting, but that's where the info came from.

I hope that helps.
Steve

**From:** Payer, David [mailto:david_payer@nps.gov]
**Sent:** Tuesday, November 14, 2017 2:16 PM
**To:** Latty, Christopher <christopher_latty@fws.gov>
**Cc:** Steve Kendall <steve_kendall@fws.gov>
**Subject:** Re: CCP question for you

Hi Chris,

Off the top of my head, no I don't know the sources. But maybe Steve Kendall could give some insight?

Don't worry about bothering me with these types of questions, I want to help if I can.

---
David Payer, DVM, PhD | Regional Wildlife Biologist | Natural Resource Sciences Team
National Park Service - Alaska Region | 240 W. 5th Ave. | Anchorage, Alaska 99501
Phone (907) 644-3578 | Fax (907) 644-3809 | david_payer@nps.gov


On Tue, Nov 14, 2017 at 1:30 PM, Latty, Christopher <christopher_latty@fws.gov> wrote:

> Hi Dave,
>
> Hope all is well down there!!! You are missing out on all the fun here at the Refuge these days :)
>
> I have a question that I feel I should already know, but don't, so I'm hoping you can help :) I'm trying to figure out how statements in the CCP were vetted so I can adequately and responsibility respond to data calls and review various documents that are being produced in a very rapid fashion these days. Hopefully you can point me the the right direction where I might find this vetting info.... For example, in the Affected Environments section under birds (4.3.6) it states,

"Common and scientific names of birds follow American Ornithologists' Union (1983) and subsequent supplements. There have been 201 species of birds recorded on the Refuge (see Appendix F). Of these, 109 are confirmed as breeding on the Refuge, and another 35 species likely breed there, although breeding has not been confirmed. Twenty-two species use the Refuge during migration only or are regular visitors, and 35 species are rare visitors or vagrants that do not regularly occur on the Refuge. In the northern foothills of the Brooks Range, Arctic coastal plain and adjacent marine waters, 158 species have been recorded, including 79 breeding species and 79 species that are migrants, visitors, or vagrants. In the Brooks Range, 107 species have been recorded, of which 68 are breeders and 39 are migrants, visitors, or vagrants. On the south side of the Brooks Range and in the adjacent boreal forest areas, 136 species have been recorded, of which 105 are breeders, and 20 are migrants, visitors, or vagrants."

Is there a document somewhere that specifically lays out where these numbers come from and how to locate supporting documentations?

The same question would apply to Appendix F (the bird list with relative densities and distributions). For example:

"Greater white-fronted goose – Common spring/fall migrant and uncommon breeder on coastal plain. Rare migrant in Brooks Range. Common spring migrant on south side."

Are there citations and/or sources for these somewhere?

Thanks so much!!!  I really appreciate any help you can offer on this!!

Cheers
Chris

--
Christopher Latty
US Fish and Wildlife Service
Arctic NWR
101 12th Avenue
Room 236
Fairbanks, AK 99701
cell 907-347-4300

**From:** Amee Howard
**To:** john_brewer@fws.gov
**Subject:** Fwd: Fourth Township
**Date:** Tuesday, November 14, 2017 6:12:35 PM

---

Sent from my iPhone

Begin forwarded message:

> **From:** "Howard, Amee" <amee_howard@fws.gov>
> **Date:** November 14, 2017 at 3:38:08 PM AKST
> **To:** "Amee R. Howard" <amee_howard@fws.gov>
> **Subject: Fourth Township**
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> *Amee Howard*
> *Congressional and Legislative Affairs*
> U.S. Fish & Wildlife Service
> Anchorage, Alaska
> Office: (907)786-3509
> Mobile: (907)229-8575
> https://www.fws.gov/alaska/
> "Conservation Begins with Hello"

**From:** Amee Howard
**To:** Hoefler, Annie (Energy)
**Subject:** Re: Arctic Refuge - 1002 acreage question
**Date:** Tuesday, November 14, 2017 6:19:30 PM

---

Hi Annie,

Confirmed by our Realty team. The fourth township is included 1.57+ million acre number.

Thanks so much!
Amee

Sent from my iPhone

On Nov 14, 2017, at 3:35 PM, Hoefler, Annie (Energy) <Annie_Hoefler@energy.senate.gov> wrote:

> Thank you, our markup begins at 9:00 am eastern, so anything you can get me before that time will be greatly appreciated.
>
> **From:** Howard, Amee [mailto:amee_howard@fws.gov]
> **Sent:** Tuesday, November 14, 2017 7:34 PM
> **To:** Hoefler, Annie (Energy) <Annie_Hoefler@energy.senate.gov>
> **Subject:** Re: Arctic Refuge - 1002 acreage question
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> Hi Annie,
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(KIC) conveyed lands are not included in the 1.57+ million acres measured for the 1002 area.

Let me know if you need anything additional.

Thanks so much!
Amee

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**From:** Hoefler, Annie (Energy)
**To:** Amee Howard
**Subject:** RE: Arctic Refuge - 1002 acreage question
**Date:** Tuesday, November 14, 2017 6:20:47 PM

---

Thank you, thank you! I really appreciate your help with this!

Annie

---

**From:** Amee Howard [mailto:amee_howard@fws.gov]
**Sent:** Tuesday, November 14, 2017 8:19 PM
**To:** Hoefler, Annie (Energy) <Annie_Hoefler@energy.senate.gov>
**Subject:** Re: Arctic Refuge - 1002 acreage question

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**From:** Christopher Latty
**To:** Steve Kendall
**Cc:** David Payer
**Subject:** Re: CCP question for you
**Date:** Tuesday, November 14, 2017 6:21:01 PM

---

Thanks much Steve!!

Sent from my iPhone

On Nov 14, 2017, at 3:54 PM, Steve Kendall <steve_kendall@fws.gov> wrote:

> Hi Chris,
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>
> I'm not sure if that addresses the question of vetting, but that's where the info came from.
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> I hope that helps.
> Steve
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> **Sent:** Tuesday, November 14, 2017 2:16 PM
> **To:** Latty, Christopher <christopher_latty@fws.gov>
> **Cc:** Steve Kendall <steve_kendall@fws.gov>
> **Subject:** Re: CCP question for you
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> Off the top of my head, no I don't know the sources. But maybe Steve Kendall could give some insight?
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> David Payer, DVM, PhD | Regional Wildlife Biologist | Natural Resource Sciences Team
> National Park Service - Alaska Region | 240 W. 5th Ave. | Anchorage, Alaska 99501
> Phone (907) 644-3578 | Fax (907) 644-3809 | david_payer@nps.gov
>
> 
> 
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Hope all is well down there!!!  You are missing out on all the fun here at the Refuge these days :)

I have a question that I feel I should already know, but don't, so I'm hoping you can help :)  I'm trying to figure out how statements in the CCP were vetted so I can adequately and responsibility respond to data calls and review various documents that are being produced in a very rapid fashion these days. Hopefully you can point me the the right direction where I might find this vetting info....  For example, in the Affected Environments section under birds (4.3.6) it states,

"Common and scientific names of birds follow American Ornithologists' Union (1983) and subsequent supplements. There have been 201 species of birds recorded on the Refuge (see Appendix F). Of these, 109 are confirmed as breeding on the Refuge, and another 35 species likely breed there, although breeding has not been confirmed. Twenty-two species use the Refuge during migration only or are regular visitors, and 35 species are rare visitors or vagrants that do not regularly occur on the Refuge. In the northern foothills of the Brooks Range, Arctic coastal plain and adjacent marine waters, 158 species have been recorded, including 79 breeding species and 79 species that are migrants, visitors, or vagrants. In the Brooks Range, 107 species have been recorded, of which 68 are breeders and 39 are migrants, visitors, or vagrants. On the south side of the Brooks Range and in the adjacent boreal forest areas, 136 species have been recorded, of which 105 are breeders, and 20 are migrants, visitors, or vagrants."

Is there a document somewhere that specifically lays out where these numbers come from and how to locate supporting documentations?

The same question would apply to Appendix F (the bird list with relative densities and distributions). For example:

"Greater white-fronted goose – Common spring/fall migrant and uncommon breeder on coastal plain. Rare migrant in Brooks Range. Common spring migrant on south side."

Are there citations and/or sources for these somewhere?

Thanks so much!!!  I really appreciate any help you can offer on this!!

Cheers
Chris

--
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<Main Refuge Bird list.xls>